Proceedings of Networkshop 4

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PROCEEDINGS OF NETWORKSHOP 4

held at the University of York

19 - 20 April 1979

Edited by

J D Service

These proceedings include the papers from Networkshop 4, a workshop organised jointly by the University of York and the Network Unit of the Computer Board and Research Councils to bring together representatives of the university community to discuss the problem of networking with special reference to PSS and campus networks.

York Computer Science Report No 23

Contents

Networkshop 4 was held at the University of York on 19-20 April 1979. The workshop was organised jointly by the University of York Department of Computer Science and the Network Unit of the Computer Board and Research Councils (now the Joint Network Team).

This workshop had a similar theme to the previous three workshops, with perhaps a greater emphasis on testing and similar practical activities reflecting the approach of the PSS starting date.

The next workshop in the series will be held at the University of Kent in September 1979.

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Morrison, Mr P. R.	Post Office
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Kennington, Mrs E. J.	Attending with Mr C. J. Kennington
Morris, Mrs R.	Attending with Mr C. Morris
Morris, Master	Attending with Mr C. Morris
Thirlby, Mrs L.	Attending with Mr R. Thirlby
Williams, Mrs	Attending with Mr M. B. Williams

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08.00	*Breakfast*
Chairman:	*Ian Service (York)*
09.00	Introductory remarks - Ian Service
09.15	Report from the Network Unit - Roland Rosner (Network Unit)
	Report from the Data Communication Protocols Units of the Department of Industry - Keith Bartlett (Protocols Unit)
10.30	*Coffee*
Chairman:	*Mervyn Williams (Network Unit)*
11.00	Technical details of the Post Office Packet Switched Service - Jon Prout (Post Office) - Mike Sands (Post Office)
12.00	Reports on machine range activities for networking — DECsystem-10 - Ian Service (York)/Rick Blake (Essex) — GEC 4000 - John Horton (GEC) — PDP-11 - Paul Kummer (Daresbury Laboratory) — ICL 1900/2900 - Roland Rosner (Network Unit) — Prime - Paul Bryant (Rutherford Laboratory) — Honeywell Multics - Kit Powell (Avon)
13.00	*Lunch*
Chairman:	*Morley Sage (Southampton)*
14.15	Connecting a host to a public network - Mike Sayers (Hatfield)
15.00	Survey of data communications test equipment - Tony Peatfield (ULCC)
15.15	*Tea*
Chairman:	*Ken Heard (AERE, Harwell)*
15.45	The Post Office Study Group 3 proposal for a transport service — General description - Peter Linington (Protocols Unit) — Addressing mechanisms - Peter Girard (Rutherford Laboratory) — Implications of Post Office tariffs on transport service - Peter Linington (Protocols Unit) — Discussion
19.00	*Sherry reception*
19.30	*Conference dinner*

08.00 *Breakfast*

Chairman: *John Thomas (SWURCC)*

09.00 Job transfer

— What facilities are needed? - Jeremy Brandon (Queen Mary College)

— The structure of a job transfer protocol - Andrew Chandler (CADC)

10.00 Local area networks

A Local network based on the table ronde communication system - Brian Wood (CAP)

10.30 *Coffee*

Chairman: *Jim Jamieson (Strathclyde)*

11.00 Local area networks (continued)

— The South West Region's requirements for a campus switch - Howard Davies (Exeter)

— The Cambridge Ring

— progress report - Andy Hopper (Cambridge)

— using the ring in production - Martyn Johnson (Cambridge)

— The University of Kent implementation - Matt Lee (Kent)

— General discussion

13.00 *Lunch*

Chairman: *Chris Morris (Network Unit/Bristol)*

14.15 Administering the use of networks - John Rice (Liverpool)

14.45 Summary and concluding remarks - Roland Rosner (Network Unit)

15.15 *Tea*

16.30 *Departure of coach for York British Rail Station*

Report from the network unit

Roland Rosner
Network Unit

REPORT FROM THE NETWORK UNIT

Progress on Standards

The Department of Industry's Data Communication Protocols Unit (DCPU) is now firmly established and the close contacts already established with the Network Unit will continue with the Joint Network Team.

The Post Office has published the technical guide for Levels 1 and 2 of X25 as they are to be implemented on PSS. Level 3 is expected at the end of May.

PSS Study Group 3 has produced a draft version of the Transport Service to be discussed in detail later in these proceedings.

The specification of the triple-X terminal protocols (X3, X28 and X29) excludes the existence of a Transport Service. A sub-group of PSS Study Group 3 (under Peter Higginson at UCL) is studying the question of achieving compatibility between triple-X and the Transport Service.

An active File Transfer Protocol Implementors Group meets regularly under Peter Linington's chairmanship.

The Protocols Unit has brought people together to start work on a Job Transfer Protocol. Further information appears elsewhere in these proceedings.

The seven-layer model of a network architecture, which has been discussed at length for about a year in BSI and ISO, is rapidly being discarded. Official agreement on protocols within the standards bodies during the next two years seems unlikely.

CCITT, the world union of telephone administrations, has now begun to take an energetic interest in high-level protocols. Since this organisation is less encumbered by external pressures than ISO, there is some prospect that they might reach more speedy agreement. It is to be hoped that the important groundwork already covered by ISO will be input into the CCITT deliberations.

The urgency of our requirements means that our main aim must be to secure the definition of those protocols which we need for our own work. Very close collaboration must be maintained with the Protocols Unit and an attentive

eye must be kept on the BSI, ISO and CCITT activities. In this way, we can hope to retain the possibility that our protocols can undergo a smooth evolution towards the agreed standards when these emerge. Moreover, the definition of working protocols can be fed to the standards bodies thereby strongly influencing their work.

Machine Range Activities

Several projects are in progress under the auspices of the Joint Network Team to provide networking facilities for various machine ranges and operating systems.

(a) DECsystem 10

Ian Service's group at York University is working on the development of a gateway between DECnet and X25. Initially, their DECsystem 10 will be connected to the SRC network using SRC's version of X25. A later stage of the project will be to connect to PSS.

CAP Ltd have been commissioned to provide a functional specification for the File Transfer Protocol on the DECsystem 10. This is an essential step prior to any detailed design and implementation that might be undertaken.

(b) ICL 1900

A feasibility study on networking facilities for ICL 1900's is being undertaken by DATASKIL. The scope is restricted to machines which run GEORGE 3 (including ICL 2900's under DME). The investigation will take into account the various networking projects on 1900's (especially MIDNET and GANNET) as well as the multitude of different front-ends.

(c) ICL 2900

The joint universities/ICL Networking Task Force has been dormant for some time. Until ICL respond formally to the Computer Board's letter of April 1978, there seems little point in reconvening. A positive reply indicating ICL's commitment to "Open System Interconnection" is believed to be imminent.

(d) PDP-11

A group of people interested in PDP-11's and networks has been convened. A proposal by York University Computer Science Department to provide X25, the Transport Service and FTP under UNIX has been accepted. Similar projects for other operating systems, especially RSX-11-M, are urgently needed.

Paul Kummer at Daresbury Laboratory is chairman of the informal group and prospective participants should contact him.

(e) Manufacturers

Several manufacturers have given varying degrees of commitment to support the standards we are asking for. Among these are GEC, PRIME and Honeywell (for Multics).

PSS

The Post Office has asked the Joint Network Team to collect the names of centres wishing to establish early packet-mode connections to PSS. So far the following have expressed such intentions:-

Centre	Date
York)	Opening Date of PSS
Essex)	
Avon)	
NUMAC)	
Cambridge)	
SWURCC)	
Birmingham)	
Nottingham)	
Leeds	Mid-1980
UMRCC	Late 1980
ULCC	Late 1980

The Computer Board is to be asked to cover the Post Office's installation costs at each of the approved sites as well as the usage charges for an initial period of experimentation with the new service.

Work Required

Figure 1 illustrates an idealised hierarchy of communications. Among the projects which will have to be undertaken on local area communications networks are:-

(a) the further development and perfecting of components based on the various principles already proposed (rings, Ethers, central switches). This must then lead to the availability of such products from manufacturers as catalogue items;

(b) the interconnection on the same campus of several local networks (which might be based on different principles);

(c) the development of gateways from local area networks to PSS or to another site;

(d) facilities for measuring and controlling access from a given site to PSS and to remote computing facilities.

Figure 1 also implies several projects for attaching equipment to networks, implementing protocols and providing commonly required components. These include:-

(a) packages for attaching mainframes and midis to PSS with support for high-level protocols;

(b) packages for attaching computers and micros to local networks;

(c) the provision of servers for local nets to allow the sharing of expensive facilities such as line printers, plotters, file storage and magnetic tape drives;

(d) terminal concentrators, PAD's and multi-hosting RJE stations for local networks and PSS;

(e) network status and information services;

(f) mailbox facilities for human communications;

(g) spooling systems so that files may be stored temporarily and delivered to their ultimate destination at a later stage (this may be needed for example when a machine designated as a destination is temporarily busy or broken);

(h) methods for dealing with existing RJE stations which use proprietary protocols and are either hardwired or not worth reprogramming.

The Joint Network Team

It is obviously too early to give details of the Joint Network Team's future programme. However, the main headings are:

(a) Communications Facilities

The JNT will act as the focal point for liaison between the university/ Research Council community and the Post Office on the use of Post Office services including PSS. The JNT will also be involved in identifying suppliers of high performance switches for use in private networks where appropriate.

The growing importance of local area networks underlines the urgency for standard components to be available as off-the-shelf products from manufacturers. Several technologies (ring, Ether, centralised switch) are currently under investigation. The JNT will attempt to see that such projects reach rapid fruition. Evidence can then be collected for subsequent recommendations on what should be the standards for the community.

The JNT will also coordinate development projects aimed at the exploitation of basic transmission and switching facilities. Examples of such projects are given earlier in this report.

(b) Standard Protocols

The JNT will participate in national and international activities on the definition of protocols required by the community. Where provisional standards are required, the team will hold the definitions agreed within the community.

Several projects are already underway on packages for implementing protocols for machine ranges and operating systems and there will be more of these in the future. Close contacts will be maintained with manufacturers in attempts to ensure that, in the longer term, standard networking facilities are an integral feature of manufacturers' products.

(c) Planning

The JNT will participate with universities and Research Council centres in the formulation of networking plans. The aim will be to ensure that, wherever possible, schemes are put forward which offer integrated communications arrangements to serve the needs of all the funding bodies.

(d) Testing and Validation

The complex nature of data communications and networking technology suggests the need for a centre of expertise to assist individual centres in implementing network connections and protocols. The possibility of this being undertaken by the JNT will receive consideration.

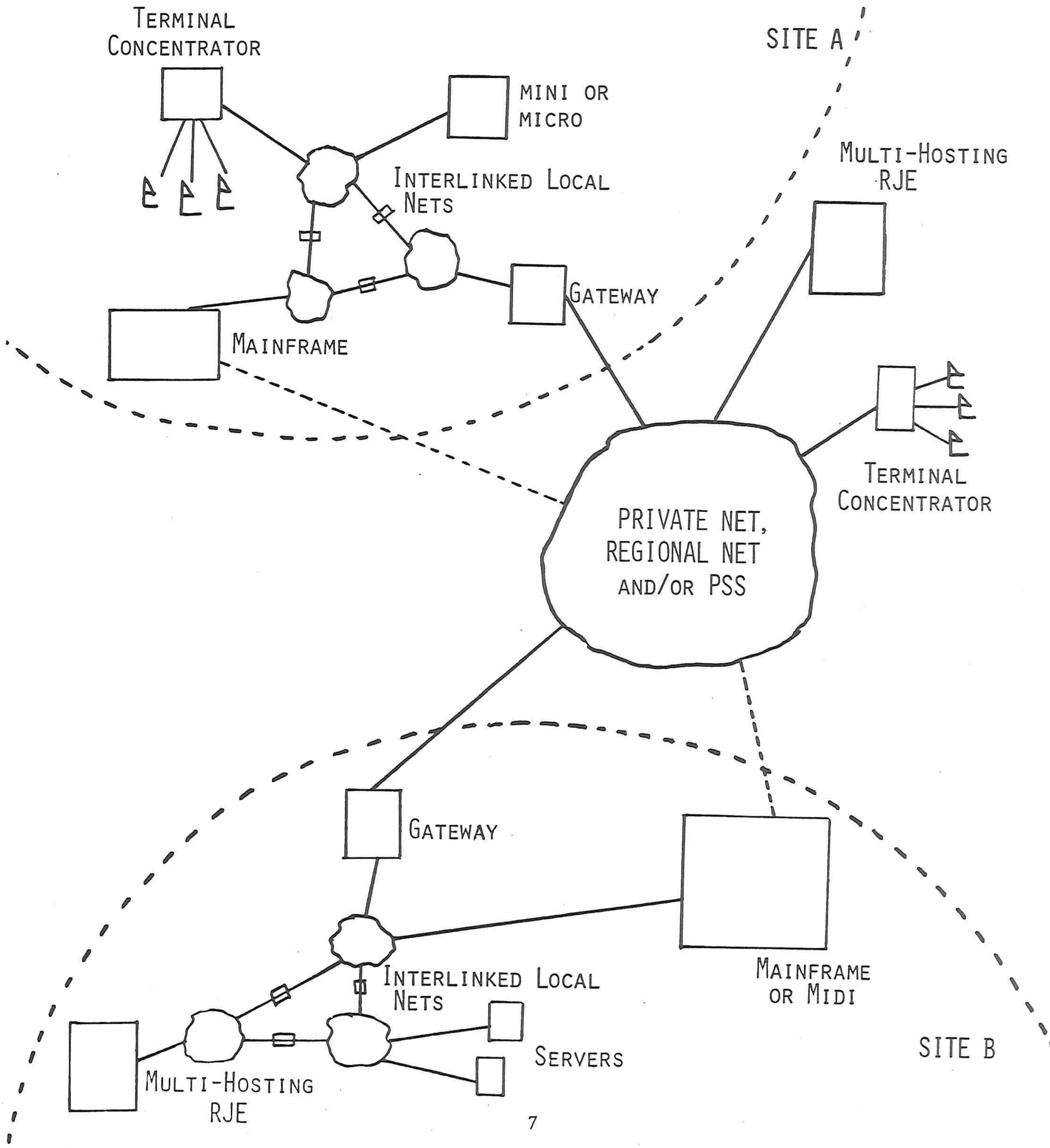
There is clearly no shortage of potential development projects. The JNT's main concern will be to reduce the risk of duplication and to make certain that what is developed has the widest possible applicability in the community. This implies the JNT's involvement in technical specifications, the monitoring of projects during execution, the negotiation of satisfactory maintenance arrangements and insistence on adequate documentation.

Dr R A Rosner
Joint Network Team

16 May 1979

Figure 1

Network Hierarchy



Report of the National Exporting Centres Group

Roland Rosner
Network Unit

REPORT OF THE NATIONAL EXPORTING CENTRES GROUP
APRIL 1979

Introduction

In March 1978, the Network Unit invited representatives from ULCC, UMRCC, NUMAC, Cambridge, Rutherford and Daresbury to an informal meeting to discuss communications questions of common interest.

Since the remote users form a high proportion of their total user communities, it was thought likely that all these centres will eventually make use of connections to PSS. The problems of effecting such connections and the need to have a focus for negotiations with the Post Office were therefore among the items to be covered.

The large size and wide geographical dispersion of these centres' dependent user communities mean that decisions which have to be taken on such matters as addressing or protocols could have an influence on what happens in many other places. The meeting was seen as offering the opportunity to discuss protocols with a view to ensuring maximum compatibility of implementations among all the centres. This would in turn help to propagate standard implementations throughout the rest of the community.

The presence of representatives from centres funded both by the Computer Board as well as by the SRC meant that the basis for future collaboration could be laid and initial steps taken towards greater integration of communications arrangements among the funding bodies.

The main conclusion of the initial meeting was that there was sufficient common ground to warrant regular meetings and these have since taken place at 2-monthly intervals.

Aims

The aims of the group are:-

(a) to exchange information on arrangements for connecting each national centre to PO PSS so as to ensure compatibility;

(b) to provide a focus for discussion with the Post Office on national centres' communications needs and problems;

(c) to collaborate on the understanding and interpretation of CCITT, ISO and BSI standards and proposals, and the achieving of compatible implementations;

(d) to consider the need for the adoption of interim standards;

(e) to ensure full exchange of information, plans and proposals within the university and Research Council community.

Some Areas Covered

All the centres have given regular progress reports on their communications and front-ending activities and this has led to discussion of common problems.

X25 has been given much attention from an implementor's point of view. All parties agree on the need for conformity with the PSS version. In the absence of the PO's technical guide, the best that can be done is to ensure that all the centres adopt the same version with simultaneous conversion to PSS being effected at a later date if necessary.

The progress being made on the definition of a Transport Service by the Post Office's Study Group 3 is being noted. Detailed information will be presented at the York Networkshop.

The need for a unified addressing scheme has been recognised and a suggested scheme, drafted in consultation with many other groups, is currently under consideration. This topic will be fully discussed at the Networkshop. The Study Group 3 Transport Service proposal includes guidelines for an addressing structure. This will in general require more bytes than are available in the Call User Data Field of the standard X25 Call Request Packet. However, the Fast Select Facility, which will be implemented on PSS, allows for 128 bytes of Call User Data. It is, therefore, recommended that all sites connecting to PSS subscribe to the Fast Select Facility to simplify the implementation of the SG3 addressing scheme.

The UK Network Independent File Transfer Protocol will ultimately be supported at all centres. The urgent need for a Job Transfer Protocol has been identified

and the Protocols Unit has now stimulated new activity in this area. Once a satisfactory definition has emerged, centres will give serious consideration to implementing it as an alternative to and eventual replacement for the current proprietary protocols.

All sites connecting equipment to networks will require data communications test equipment. A survey of available products has been conducted and the results will be presented at the Networkshop. It has been suggested that a pool of recommended devices and a suite of useful software for them be kept centrally and loaned to any sites wishing to use them.

Timescales for PSS Connections

The expected dates by which centres will be capable of offering an initial service to users via PSS are

UMRCC	Late 1980
ULCC	Late 1980
Cambridge	Opening date of PSS
NUMAC	Opening date of PSS
Rutherford	Opening date of PSS
Daresbury	Opening date of PSS.

Relations with the rest of the Community

It is not intended that the group should be yet another committee defining protocol standards. A member of the Department of Industry's Data Communication Protocols Unit participates in the group's meetings to clarify problem areas. The emphasis is very much on the pace and compatibility of implementation so that the major centres are aware of each other's work and can take steps to ensure the capability to interwork at all stages of their separate programmes. Where decisions are required which could have repercussions in other places, prior consultation will be organised by the Joint Network Team and regular reports of the topics discussed will be circulated for information and comment.

Roland Rosner
Joint Network Team

10 April 1979

The Data Communications Protocols Unit

Keith Bartlett
Protocols Unit

The Data Communication Protocols Unit

The problems of 'user' standards in networks such as Transport Service and the higher level protocols have been recognised by the formation of national and international standards committees which have, in turn, formed a number of working groups. The effectiveness of the committees and working groups is dependent upon the expertise of the membership which is drawn from users, manufacturers and research institutes with particular interest in the subject matter. This membership must be backed up by a comprehensive programme of development and investigation. The rapid progress in the use of networks which has taken place in the last two years means that the identification of the necessary standards and their relationship to each other is not yet complete.

Research and development on these standards is carried out in the Post Office and in establishments funded by the Science Research Council, the Computer Board for Universities and the Department of Industry but this work has not been co-ordinated and many subjects have been left uncovered.

This has led to the formation of a Data Communication Protocols Unit (DCPU) at the National Physical Laboratory with a Steering Committee chaired by Morley Sage of Southampton University. Roland Rosner is another member of that committee.

The Unit will work in conjunction with BSI committee DPS/20 and the chairman, Frank Taylor, is another member of the Steering Committee.

The purpose of the Unit is to coordinate and encourage the necessary development work on the identification and generation of protocols and standards for general purpose data communication networks. At present, the Unit has a predicted lifetime of only two years because it is important that these developments be carried out early enough to allow immediate, effective use to be made of switched networks as they become available in the UK and enable the UK to make effective contributions to international standards.

The Unit will also act as a clearing house through which the present and anticipated needs of the users are brought to the attention of those developing the standards.

The Unit will encourage and monitor appropriate development work on higher level protocols and help to bring this work to the level of national and international standards. The full requirements and implications of standards in computing and communications are not yet clear and part of the work will be an assessment of how these standards must be supported and maintained. The Unit will provide information on the existence and state of communication protocol use and development in the United Kingdom. It will maintain a reference library of relevant literature and specifications and make this available as required.

The Unit held a small workshop on the Transport service problem just before Christmas. The raised some points for further consideration by the Working Group on Transport Service from Post Office Study Group 3. Since then, this group has completed a draft proposal for a Transport Service interface and an interpretation of this on an X25 network. This document is being circulated through the Unit.

Another meeting was held at ULCC to consider how the Remote Job problem might be tackled. This resulted in a very small working group convened by Andrew Chandler of CADC. Additional members for this group would be welcome. The first target will probably be to define a job transfer protocol, based upon FTP, for use between intelligent hosts. The effort available for this work may not be sufficient and the DCPU will try to contract the services of a suitable consultant.

The Unit is in contact with French and German organisations interested in the early availablity of suitable protocols.

Keith Bartlett
DCPU

X25 Frame level interface for packets (FLIP)

Jon Prout
Post Office

NP4 PACKET TERMINAL SOFTWARE

USER INFORMATION NOTE 31

X25 FRAME LEVEL INTERFACE FOR PACKETS (FLIP)

CONTENTS

THQ/NP4.1.4/NRH

Issue 3
April 1979

1 INTRODUCTION

This process allows access to the X25 frame level interface. Keyboard commands allow both level 2 frames and level 3 packets to be transmitted and monitored. The use of FLIP requires a special set-up procedure. The full user interface has not yet been defined - please note the warnings in Section 6.

2 COMMANDS

The following main commands may be entered:-

EN	To terminate the FLIP process.
PX	To cause FLIP to transmit a level 3 packet (see Section 3).
TR	To display the last few frames received or transmitted (see Section 4).
OFF	To stop the display of frames (see Section 4).
FX	To cause FLIP to transmit a level 2 frame (see Section 5).

3 THE PX COMMAND

This command will cause FLIP to pass a packet, of the required format, to level 2 for transmission. Level 2 will handle the transmission automatically (ie sequence and ack). The type of packet sent depends upon the parameters given below:-

PACKET TYPE (DTE DCE)	COMMAND
CALL REQUEST	PX CALL LCN, CING.A,CED.A,FAC.PAIR,....
CALL ACCEPTED	PX CAA LCN
CLEAR REQUEST	PX CLR LCN,CAUSE,CODE
CLEAR CONF	PX CLC LCN
DATA	PX D LCN,PR,PS,Q,M,DATA
INTERRUPT	PX INT LCN,USER DATA
INTERRUPT CONF	PX INC LCN
RR	PX RR LCN,PR
RNR	PX RNR LCN,PR
REJ	PX REJ LCN,PR
RESET REQUEST	PX RST LCN,CAUSE,CODE
RESET CONF	PX RSC LCN
RESTART	PX RES CAUSE,CODE
RESTART CONF	PX REC

NOTES

LCN - Logical Channel Number 1-3 Hex digits.

CING.A - Calling Address 0-15 BCD digits.

CED.A - Called Address 0-15 BCD digits.

FAC.PAIR - Facility pair	3-4 Hex digits.
CAUSE - Cause byte	1-2 Hex digits.
CODE - Code byte	1-2 Hex digits.
PR - P(R)	1 Hex digit.
PS - P(S)	1 Hex digit.
Q - Q bit to be set)) M - M bit to be set)	Q or M may be omitted. If both present the order must be Q, M.
DATA - IA5	Up to (and including) <CR> go into packet- should not start with Q or M.

USER DATA - User data byte 1-2 Hex digit.

Only 1 space (or,) between any field.

4 THE TR COMMAND (FRAME TRACE)

Format TR or TRI.

Function The trace command instructs FLIP to display all frames (all I frames for TRI) sent or received by the tester. When in the Trace mode, other commands may be entered but the display will 'break in' if it has a frame to show, eg

```
.TR
.                               FLIP prompt
> RR Ø                          Trace 'break in'
< RR 2
FX SARM                         Local prompt (no '.'), user enters next command
```

The trace may be stopped by the OFF command or by terminal 'break' (Reset).

Note The size of the trace queue is limited and works on a 'wrap round' basis.

When using trace on a slow character terminal some information will not be displayed if the sequence exceeds 7 frames.

A frame is only displayed once, the format is given below:-

< A L2 TYPE   P/F   N(R)   N(S)   Send frame

> A L2 TYPE   P/F   N(R)   N(S)   Receive frame

A	L2 TYPE	P/F	N(R)	N(S)
1 OR 3	I SARM DISC UA CMDR REJ RNR RR	P=P bit set F=F bit set	RR RNR frames REJ only I	I frames only

Each I frame is also described in level 3 terms as follows:-

L3 TYPE   GLCN   P(R)   P(S)   XXXX

L3 TYPE	GLCN	P(R)	P(S)	XXXX
CLR CLC CALL CAA RST RSC RES REC INT INC RR RNR REJ D ?? —— L3 TYPE unknown	First 2 bytes of packet	RR RNR Packets REJ only D	D packets only	Second 2 bytes of packet

5 THE FX COMMAND

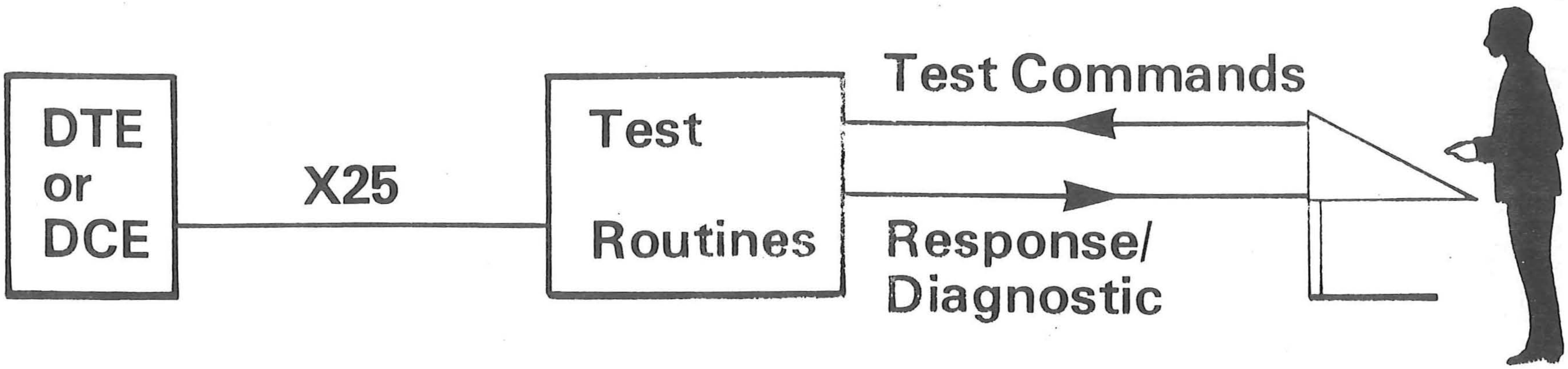
The command will cause FLIP to transmit a level 2 frame according to the following parameters:-

FRAME TYPE	COMMAND
SARM	FX SARM
DISC	FX DISC
UA	FX UA
CMDR	FX CMDR
REJ	FX REJ
RNR	FX RNR
RR	FX RR
I	FX I XXXXXXXX (XX = Hex digits)

6 USE OF THE FLIP PROGRAM

If a command or parameter cannot be found the signal ?? is given. No syntax or range checks are made on PX or FX commands. The level 2 protocol runs automatically - misuse of the FX command may cause level 2 to 'lock up' and hence require system reload.

TESTING AID PHILOSOPHY
PSE SITE

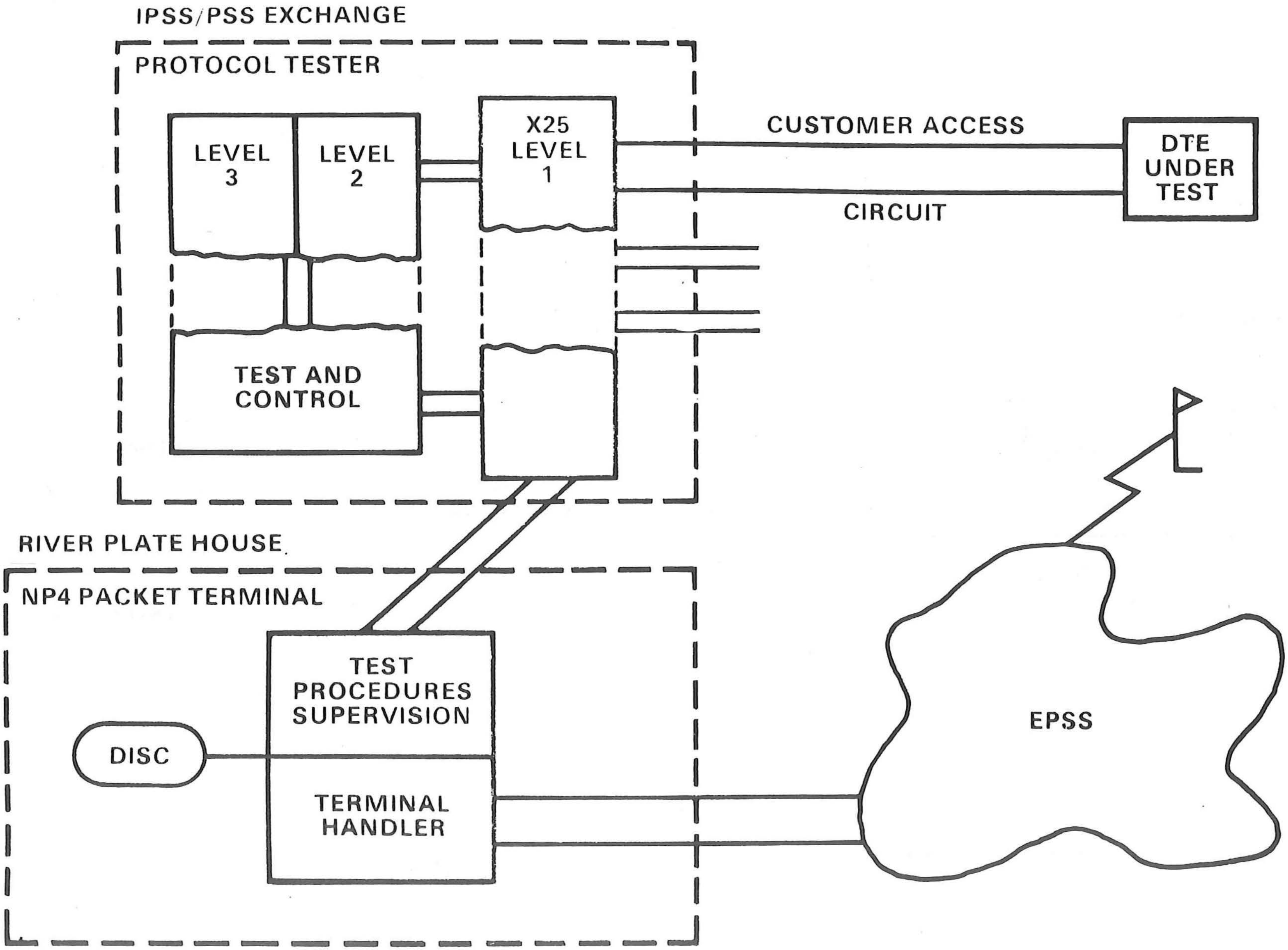


1. DTE Development/Debugging

2. Demarcation Resolution

3. Permission To Connect (Approval)

X25 PROTOCOL TESTER – TEST CONFIGURATION (CONTROL ACCESS)



X25 PROTOCOL TESTER SOFTWARE BREAKDOWN

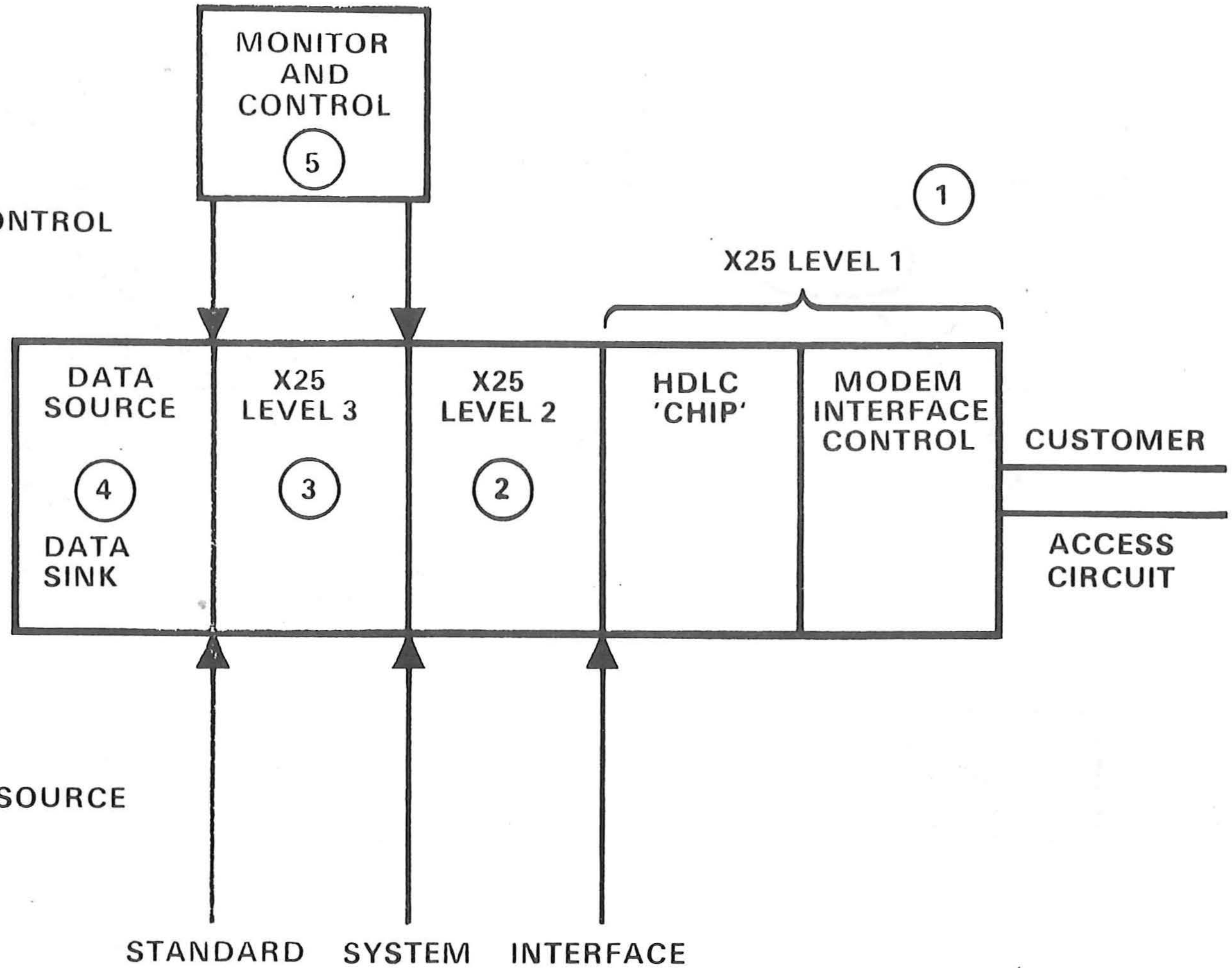
1 CUSTOMER MODEM CONTROL FRAMING ETC

2 X25 LEVEL 2

3 X25 LEVEL 3

4 APPLICATIONS – DATA SOURCE AND DATA SINK

5 CONTROL AND TEST SOFTWARE



A I M S   O F   T H E   T E S T E R

1. TO PROVIDE DTE MANUFACTURERS WITH A SELF SERVICE DEVELOPMENT AID.

2. TO ENCOURAGE A MODULAR APPROACH TO DTE IMPLEMENTATION.

3. TO ASSIST IN EVALUATION OF DTE FOR PERMISSION TO CONNECT PURPOSES

4. TO PROVIDE SUBSEQUENT MAINTENANCE AID.

OTHER AIDS AVAILABLE TO THE P.O

1. DIAGNOSTIC AIDS AT THE NETWORK MONITORING CENTRE.

2. DATASCOPES.

3. TEKELEC TE 92 X25 ANALYSER.

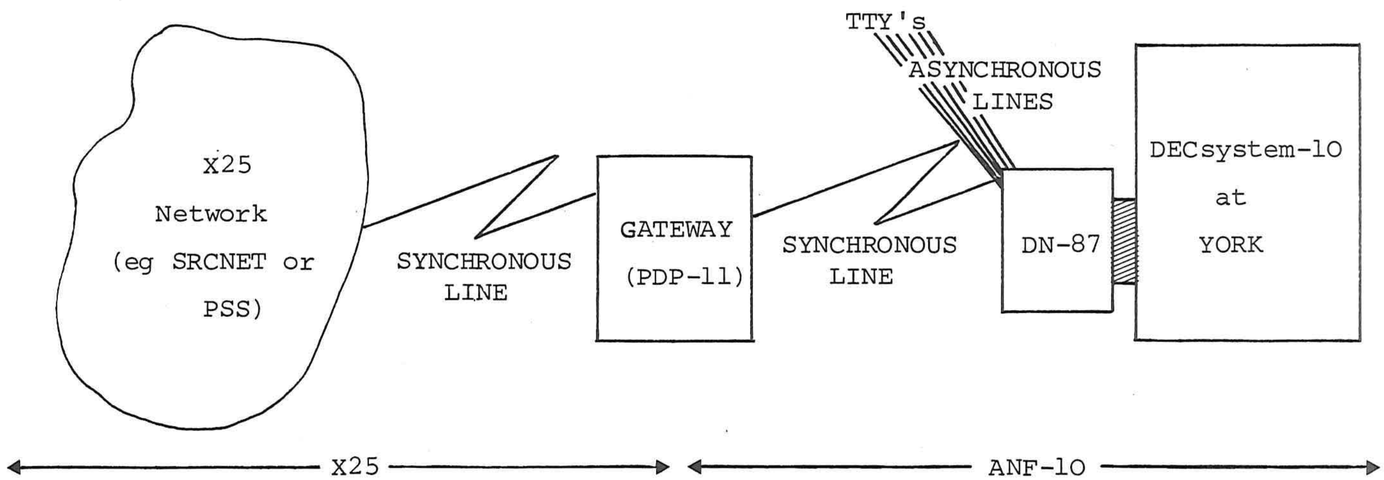
4. ATLANTIC RESEARCH INTERSHAKE.

X25 Networking on the DECsystem-10

Ian Service
York

The University of York has received support to implement an X25 network connection for the DECsystem-10. This DECsystem-10 network will initially aim to connect with SRCNET which is already X25 based but will ultimately allow connection to PSS.

The network link will be based on an existing DEC-10 only network facility called ANF-10 (Advanced Network Functions also occasionally called DECnet-10), and will be implemented as an internetwork link or gateway between ANF-10 and the X25 network. This gateway will be implemented on a separate PDP-11 computer which will run all the software to translate between the two networks.



As few changes as possible are being made to the DECsystem-10, the only changes to the monitor being the addition of some tables to store where incoming network users come from. All changes should be completely transparent to the normal DECsystem-10 user.

File Transfer: Rick Blake (Essex)

As a separate exercise CAP have been commissioned to write a functional specification of an FTP-B implementation for the DECsystem-10.

PDP-11 Network Users Meetings on 20 December 1978 and 14 March 1979

Minutes

PDP11 NETWORK USERS MEETING

DARESBURY LABORATORY, 20 DECEMBER 1978

With the announcement of PSS by the Post Office, it was thought appropriate that a meeting should be set up to bring together people concerned with connecting PDP11's to networks in general and to PSS in particular. The aims of the meeting were:

1. to identify common requirements;

2. to discuss schemes of general applicability;

3. to specify the technical details of implementation;

4. to formulate a collective programme of work aimed at reducing duplication of effort and diversity of implementation.

A fairly representative group of potential network users attended the meeting despite the bad weather. A survey of those present showed that there was a general intention to connect to networks but very little effort available for implementation. The possibility of a centrally provided and maintained implementation was discussed and agreed to be worth pursuing. The following operating systems were of interest:-

OS	Number of sites
RSX-11-M	9
RSX-11-D	1
UNIX	8
RT-11	2
RSTS	3

The meeting agreed that a small working group should be set up to investigate the problems and possibilities of a centrally provided implementation. The working group was to determine what was required and what was available. This could then form the basis of a set of projects or contracts to provide the required software.

The working group was to produce a report by 16 February 1979 so that it could be distributed well before the next full meeting. The working group's report is attached to this summary and will be discussed at the next meeting which will be held at:- University of London Computer Centre,
20 Guilford Street,
London WC1N 1DZ
on 14 March 1979, at 11.30 am.

Paul Kummer
12 February 1979

1. Introduction

The widespread use of PDP-11's throughout the university and Research Council community and the intention of several users to connect their machines to networks have stimulated an investigation of methods for providing the appropriate facilities. Following a meeting attended by several PDP-11 users organised by Daresbury Laboratory in December 1978, an ad hoc group was formed to draft a set of networking capabilities, to investigate what work had already been done and to suggest means of providing fully engineered packages to achieve the required functions. Manpower constraints mean that a most desirable objective is to reduce duplication of effort and diversity of implementation possibly by having a limited number of well documented packages which are held and maintained centrally and distributed to installations requiring them.

2. Requirements

Figure 1 lists the main operating systems of interest to the community and figure 2 is an initial set of networking facilities to be provided.

(a) Communications Hardware

Several pieces of hardware are available for handling communications lines. There are advantages in using standard products supplied by Digital but it may be worth investigating the hardware which some groups have built themselves. Moreover, Digital's more recent offerings also need to be evaluated.

(b) X25

The Post Office PSS version of X25 is the definitive standard which ought to be followed. This will accept both BSC and HDLC frame structures and both LAP and LAPB classes of HDLC procedure.

(c) Transport Service

The PO Study Group 3, in conjunction with the Department of Industry's Protocols Unit, is working on the definition of a "thin" Transport Service layer. A preliminary document has already been circulated. By the summer, a workable version should have been published.

(d) Terminal Support

There is a need to support remote terminals accessing a PDP-11 over a network and X29 will thus be required. For terminals attached directly to a PDP-11 wishing to access remote facilities over the network, the PDP-11 will have to act as a PAD in conformity with X3 and X29.

(e) File Transfer

The standard UK File Transfer Protocol is required.

(f) Job Transfer

It is likely that work will soon begin on the definition of a basic Job Transfer Control Protocol which will use the facilities of FTP for the file shipment parts of the Job Transfer sequence.

(g) Multi-Hosting RJE

PDP-11's frequently act as RJE stations and, once a satisfactory network job transfer protocol has been defined, there will be growing demands for multi-hosting workstations. This item is included for completeness though such software would not necessarily be used with any of the operating systems mentioned.

Current Projects

Work is believed to be in progress on the provision of separate solutions for each operating system. Attention has, however, been drawn to the work of Colin Bradbury at UCL who has produced a set of modules for X25 designed to be coupled to any operating system. Figure 3 illustrates the structure and shows that only the interface module between COMSYS and the operating system requires construction in each case. This approach has the attraction of providing common implementations of the same function under different operating systems with the important attendant advantage of maintainability. It has been estimated that construction of the interface module to a given operating system is about 30-50% of the work that would have to be undertaken if the complete solution were built from scratch.

Provisional Recommendations

1) A study and evaluation should be made of the communications line drivers available both from Digital and from groups who have built their own.

2) Bradbury's work on X25 provision seems a good basis for a general solution. The problems in coupling this software to a number of operating studies should be investigated.

Bradbury intends to do this for UNIX but there will not be adequate manpower for the subsequent development of a fully documented and maintained package for general use in the community. The Computer Science Department at the University of York has expressed interest in this project and has manpower available. It is recommended that York at UCL collaborate in the first stage which, if successful, would lead to a possible contract for York to develop the UNIX package.

3) The linking of Bradbury's X25 software to the other operating systems is for further study. Priority should be given to RSX-11-M and a suitable group or software house should be sought to undertake this.

4) Items (c) to (g) in the list above are for further study.

R A Rosner
14 February 1979

FIGURE 1

OPERATING SYSTEMS

RSX-11-M

UNIX

RSTS

RT-11

RSX-11-D

Figure 2

FACILITIES FOR NETWORKING

Communications Hardware

HDLC Framing

BSC Framing

PSS LAP

PSS LAPB

PSS X25 Level 3

PO SG3 Transport Service

X3, X29

UK FTP

Job Transfer Control Protocol

Multi-hosting RJE capability

FIGURE 3

STRUCTURE OF UCL SOFTWARE

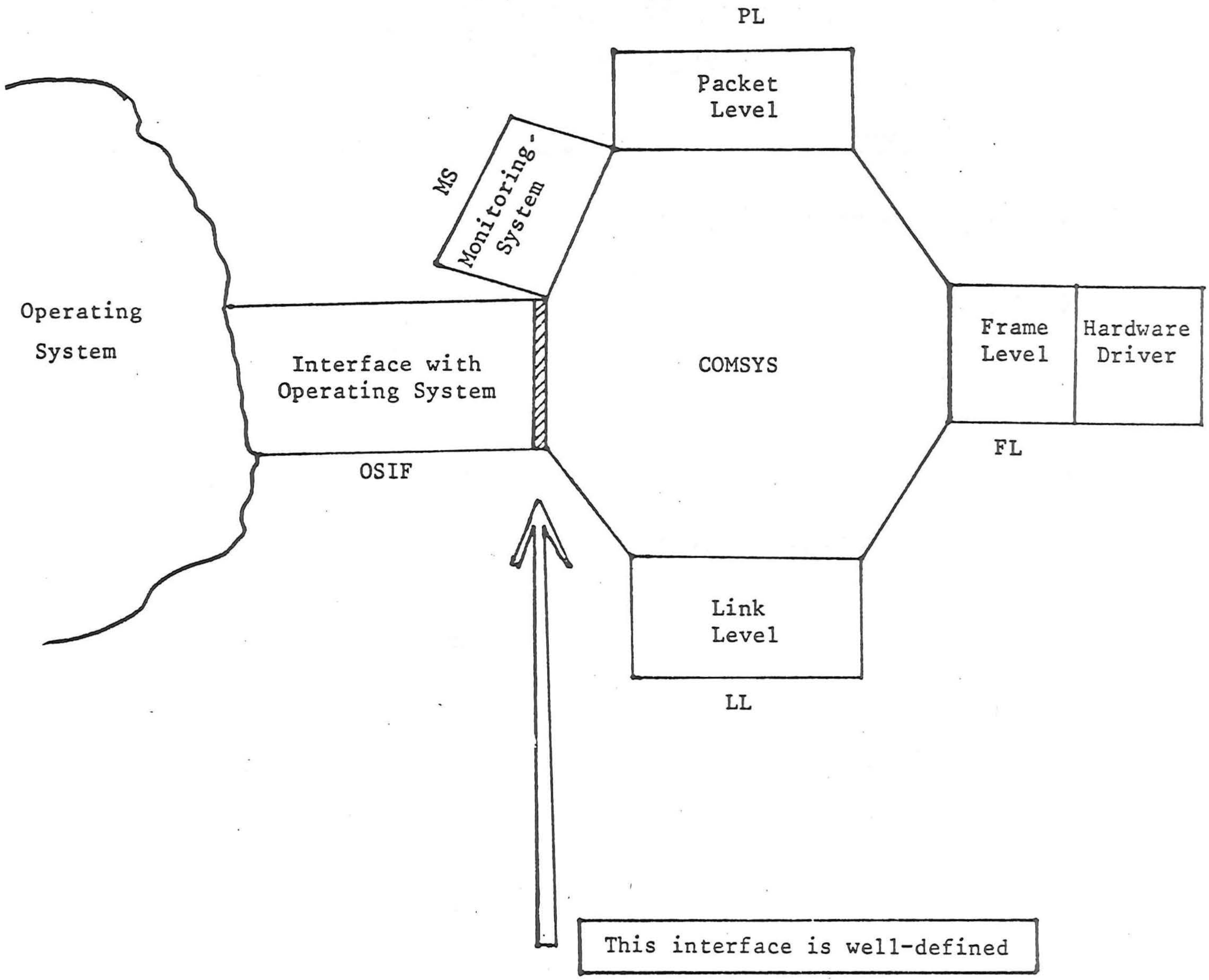


FIGURE 4

UCL ESTIMATES OF MODULE SIZES
(EXCLUDING BUFFERS)

ITEM	SIZE OF CODE (IN 16-BIT WORDS)
FRAME LEVEL + HARDWARE DRIVER	500
LINK LEVEL	1000
PACKET LEVEL	2200
COMSYS	560
INTERFACE WITH OPERATING SYSTEM	500
	4760

PDP11 NETWORK USERS MEETING 2ND MEETING

UNIVERSITY OF LONDON COMPUTER CENTRE 14 MARCH 1979

Matters Arising from First Meeting

There are apparently more RT11 installations than indicated in the survey taken at the first meeting. (It is extensively used in the London medical schools.)

It was decided to give priority to the following operating systems:

RSX11-M

UNIX

RT11

Discussion on Working Group Paper

It was stated that PSS would not support Bisynch framing.

After a short discussion it was decided to leave LAP in the specification for compatibility with EURONET.

Two new DEC systems may be released soon - RSX11-M3.2, with a few additions to present versions, and RSX11-M plus which will need a PDP11/70.

It was agreed that implementations should go ahead based on the UCL scheme. The first implementation should be done with the needs of other operating systems in mind so that it can be used as an example.

An example of the OS interface box now exists at UCL.

It was stated that as RT11 only consists of two tasks then the PAD facility may not be required.

Implementations

UNIX

York are interested in doing this implementation and a request is being made to the Distributed Computing Panel of the SRC for the necessary funding. This project will also probably include high level protocol implementation.

RSX11-M

Bristol are interested in this but a decision will have to wait until they know if they are going to get suitable hardware.

Otherwise this is a good candidate for a commercial contract.

RT11

Exeter are interested in this - certainly for Q-bus machines.

RSTS

Hatfield may be interested.

The above institutions are going to produce detailed proposals. It was agreed to leave the question of communications hardware until later.

High Level Protocols

A working group is being set up by the DoI's Data Communications Protocols Unit to look into Job Transfer Protocol. The group will concentrate on a spool-to-spool protocol and is attempting to define a protocol quickly. This may involve a commercial contract to get the required effort.

A draft document of SG3's Transport Service will be presented at the next Networkshop (19 - 20 April). It was agreed that the TS should be part of the X-25 implementations mentioned above but that mechanisms should exist for bypassing the TS (for X29).

There was a discussion on whether the HLPs should be implemented at the same site as the X25 implementations. The argument for a separate site is that it will allow parallel development and thus shorten timescales. Interest in implementing FTP under UNIX was expressed by Durham and Essex. It may also be possible to issue commercial contracts. No decision was made.

PADs

It was agreed that there is a general requirement for private PADs. One main problem is to decide which terminal protocol(s) to support. The only protocol in intensive use presently is the EPSS ITP used in the SRC network. However, this protocol is not a serious contender for future standardisation.

It was agreed that X29 had to be supported in hosts, but for private PADs there are at least six contenders of which XXX is only one.

A decision was deferred for lack of information and also to wait to see what comes out of the projects described above.

Documentation

It was stated that the Joint Network Team would distribute the required documentation to interested parties. In the meantime, the present Network Unit will endeavour to distribute documentation to those requesting it.

Next Meeting

The next meeting has been provisionally arranged for 11.00 a.m. on Tuesday 3 July at ULCC.

P S Kummer

4 April 1979

Networking with the PRIME computer

Paul Bryant
Rutherford Laboratory

Networking with the PRIME computer

With the latest release of the PRIME operating system PRIMOS X25 a la Telenet is offered. This provides both HDLC and Binary Synchronous link level. Rutherford's interest is to connect the PRIME to the SRC X25 network. Unfortunately, the Telenet Binary Synchronous only retains the Binary Synchronous framing around LAP and LAP-B while SRC net is based on the IBM held duplex link level.

Three options are open. Firstly the PRIME code could be modified (a non trivial job). Secondly the node could provide HDLC. Thirdly the node could provide Binary Synchronous compatible with PRIME. Unfortunately, none of these alternatives is trivial and also Rutherford is short of staff.

Even when the link level problem is solved there is no guarantee that the call levels will be compatible but a preliminary examination of the code is encouraging.

At the higher level PRIME provides triple X and PRIMENET. PRIMENET provides interactive, file transfers and remote file access between PRIMES.

Rutherford have implemented FTP-B between their PRIME and GEC computers over an asynchronous link. If the connection to SRC net proves possible then it is intended to implement FTP-B over X25 and possibly the old EPSS ITP which SRC uses. Even if the PRIME cannot be connected in the short term it is quite likely that FTP-B may be implemented by PRIME and/or SRC.

Paul Bryant
ATLAS Computing Division
Rutherford

The connection of a DECnet host to a public network (EPSS)

Mike Sayers
Hatfield Polytechnic

The Connection of a DECnet Host to a Public Network (EPSS)

M.D. Sayers
Head of Software and Services
The Hatfield Polytechnic Computer Centre
P.O. Box 109
Hatfield Herts U.K.

1. Abstract

This paper describes the connection of an ANF10 DECnet network based on the DECsystem 10 processors at The Hatfield Polytechnic to the Post Office's Experimental Packet Switched Service (EPSS). Some problem areas are identified and some suggestions made for improvements.

2. In January 1978 the central computing service at Hatfield was provided by a DECsystem 1050 serving around 60 simultaneous interactive users. A new front end processor (DN87) had recently been added and an ANF10 DECnet network was beginning to grow from it, starting with a remote line concentrator and RJE station looking like a DEC DN82 but actually being a GEC 2050 with Hatfield software in it.

New computing systems were being planned and it was fairly obvious that a substantial local ANF10 network would be required. In fact, at the time of writing this paper, the network is as in figure (1). Not all links are yet operational but are hoped to be by the end of 1979.

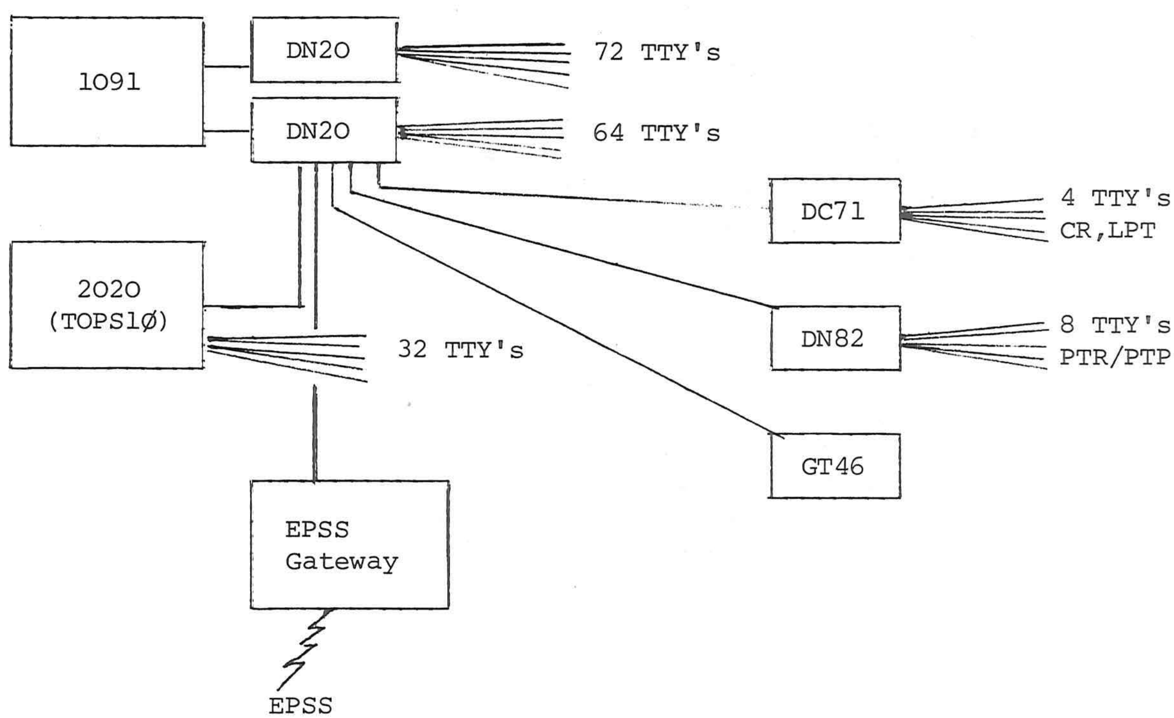


Figure 1. The Hatfield Configuration

It was clear that access to EPSS and subsequently PSS would be required from terminals on any of the processors and that the interconnection of processors would be via ANF10 DECnet. It thus seemed reasonable that access to EPSS should be via an ANF10 to EPSS gateway. This should provide access to EPSS from any terminal on the ANF10 network and access from EPSS to any host on the ANF10 network.

It is important to note here that, strictly speaking, DECnet applies to the PDP-11 and DECsystem 20 network product which is different from the DECsystem 10 network. The DECsystem 10 network software is properly called ANF10. This paper deals only with this DECsystem 10 version of DECnet.

3. The Users View of the Gateway

3.1 The user originating from ANF10

To a user whose terminal is connected to some part of the ANF10 network the Gateway looks like an ANF10 host. Thus the user may get to the Gateway by typing a SET HOST command. After the successful execution of this command the user is connected to a command decoder in the Gateway. Commands available to him at this stage are:-

CONNECT	address
DISCONNECT	
STATUS	
ESCAPE	new-escape-character

CONNECT attempts to set up an EPSS call to the given address, DISCONNECT clears the currently open call (if any) and STATUS types information about the gateway channels which are in use.

Additionally, the Gateway recognises FTP to mean that command level replies to the user should be encoded so that they may be recognised easily by processes such as FTP. It also ensures greater transparency of data than a normal virtual terminal call.

After SET HOST the user is initially in command mode and the Gateway discards all data received except valid commands. Once an EPSS call has been successfully opened the Gateway sends all data transparently with the exception of any record following the currently active escape character. Such records are treated as Gateway commands. The escape character may be changed by command.

For a normal virtual terminal call, data received from an ANF10 terminal for output to EPSS is record blocked. This means that data characters are accumulated until a character within the pre-defined set of allowable break characters is found. The complete record is then sent to EPSS. This results in much improved packet filling. Invoking the FTP command disables record blocking and all messages are sent to EPSS exactly as received from ANF10.

Record blocking of the type described above imposes no problems for our users who wish to access line oriented external systems. In practice it has not been found to be a problem with accessing other character oriented DECsystem-10's. The only "commonly used system program" which cannot easily be driven is DDT - the dynamic debugger for assembly language programs and this is fortunately hardly ever used on external DECsystem-10's. I think the reason is that our users need to access external computers in order to use application programs or data bases which are not available on our own system. They do not need to go to another DECsystem-10 to play with the assembler!

3.2 The user originating from EPSS

The Gateway supports two protocol process addresses for incoming calls, the EPSS character virtual terminal protocol (CHVPT) and a "process hook" for file transfer protocols. The Gateway structure allows for multiple protocols but others have not really been needed. It really is quite surprising how much useful work has been done on both incoming and outgoing calls to and from a variety of machines just using CHVPT. When one considers that CHVPT contains no terminal control facilities at all it is even more surprising.

For the incoming CHVPT user (calling on process address 300) the Gateway provides a transparent data path to the ANF10 host. The sequence of events for an incoming call is as follows. When the Gateway receives an EPSS Call Originating Packet (COP) it attempts to connect to an incoming TTY handler channel on the first ANF10 host. If the connection succeeds a FRP successful response is sent to EPSS and the call is fully established. The incoming user is then connected, on the ANF10 side of the Gateway, in exactly the same way as he would be if he originated at a TTY on the ANF10 network. Thus if, for instance, he wishes to locate himself at a different ANF10 host this can easily be done by using the SET HOST command. This is processed in the standard ANF10 way by the Gateway.

As far as ANF10 is concerned the Gateway looks like a single ANF10 host node. All outgoing TTY's or TTY handlers look as though they are located in the Gateway and all incoming TTY's also appear to be located at the Gateway. Thus ANF10 has no knowledge of the network on the far side of the Gateway. Similarly, the EPSS network has no knowledge of the structure of the ANF10 network.

4. The EPSS Service Process

When the Gateway was first implemented there were very few network terminals at Hatfield. Most of the terminals on the DECsystem 1050 (KA10) were driven as local terminals through a 680I concentrator. These terminals were consequently not able to SET HOST to the Gateway. The EPSS service process (EPSSER) was developed as a temporary solution to this problem until all the terminals became network terminals after the transfer of computing facilities to the new DECsystem 1091. EPSSER, however, had developed a number of very useful facilities and refused to wither away.

EPSSER as originally conceived was to provide a transparent data path through the DECsystem-10 to connect local terminals to outgoing channels in the Gateway. This was done by connecting to RDX devices in the Gateway. Very soon EPSSER developed two additional and extremely useful functions; command interpretation and logging.

It was soon found that the command decoder syntax in the Gateway, which was severely limited by memory constraints, was cumbersome for users; particularly the address digit string in the CONNECT command. Mnemonic addressing is much easier and EPSSER was therefore given the ability to intercept CONNECT commands and translate host names into address digit strings before passing the command (in abbreviated form) to the Gateway. The second function which EPSSER was extended to perform was logging. The user was able to instruct EPSSER to open a file on the DECsystem-10 and to copy all terminal traffic into this file. This was found particularly useful by those users whose terminals were VDU's and it worked sufficiently well that it was used extensively for file transfer over the network. The user just "typed" the file from the remote system and logged it on ours. The logging facility also worked in reverse and allowed input to the Gateway to come from a file instead of from the users terminal. Using this technique it is possible to run interactive jobs on a remote system from JCL files stored on our DECsystem-10.

5. Protocol Mapping in the Gateway

EPSS and ANF10 have a roughly similar protocol level structure as shown in figure (2).

ANF10	EPSS
(Device Driver)	
Data Access Protocol (DAP)	CHVPT or FTP
Network Command Language (NCL)	EPSS Call level
DDCMP (Communications line protocol)	EPSS Link level

Figure (2)

Unfortunately the physical link protocol and the logical call protocol levels are not as easy to separate in EPSS as in ANF10 and this caused the software structure in the Gateway to be more complicated than I would have liked. In addition, there was not sufficient correspondence between the protocols to allow simple mapping of data below the device level. Data had to be unpacked from one family of protocols and then packed up into the other. The reasons for this are too complex to be described in detail here but the main ones are that the maximum packet sizes are different, the device control facilities are different (or non-existent!) and the flow control and buffering techniques are different. The data path is shown diagrammatically in figure (3).

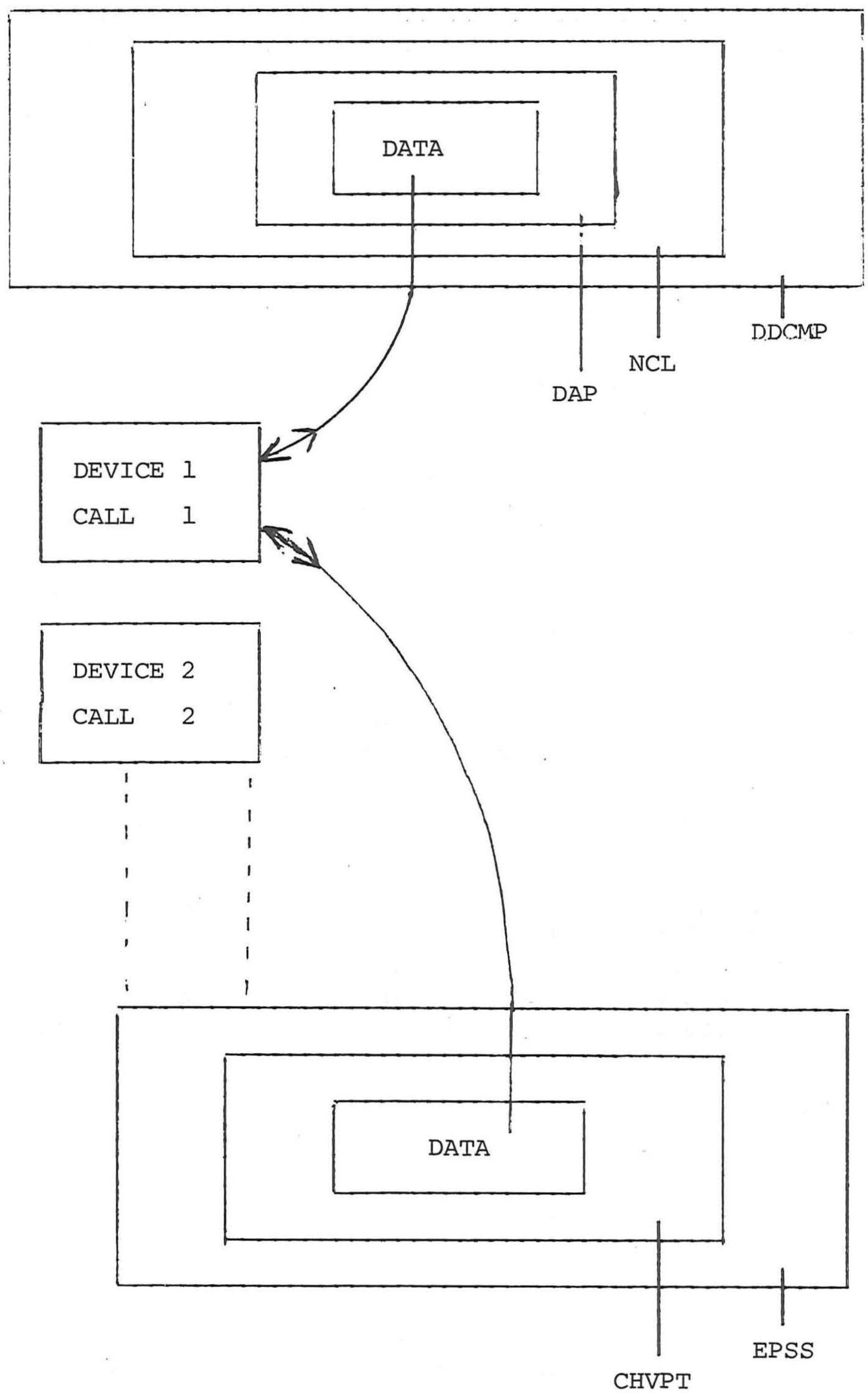


Figure 3. Data path in Gateway

The Gateway software is based on the DEC DN80 series node software with some internal changes and the addition of command decoder, flow control, protocol converted and EPSS driver modules. It is queue driven with messages destined for the Gateway being added to a TO EPSS queue from which they are removed by the protocol decoder. This extracts data and hangs it on the appropriate device/call block queue from where it is subsequently removed, repacked and added to the EPSS line output queue for transmission. Flow control back pressure is maintained in both networks by restrictions on the data queue lengths on the call blocks. The number of outstanding messages allowed within the gateway depends on the free memory available.

6. Features and Problems

The following discussion is in the nature of a set of notes on features or problems in the system.

The Gateway overheads in terms of processing required per message is fairly heavy because of the need to unpack data to the device level in both directions. This has not proved to be a problem however, even though our Gateway machine is a relatively slow PDP-11/15. The bottleneck in the system is the slow end to end data throughput of the EPSS simplified protocol which is roughly one quarter of the line speed. The extra delay introduced by the Gateway does not noticeably increase the interactive terminal response time over that experienced by our ordinary ANF10 terminals. Strongly enough response is better for incoming calls than on our locally concentrated (680I) terminals.

Flow control is difficult mainly because data flow control on an EPSS call is symmetric but, in ANF10 DAP, Data Requests are only used for output from command terminals. There are some internal hacks in the Gateway to produce flow control back pressure in the inwards (to DECsystem-10 terminal handler) direction.

It is a problem knowing what to do with EPSS service signals particularly how to pass meaningful information back to users. The Gateway provides two levels of Command/Service signal information. One gives text messages suitable for interactive users and the other gives encoded messages suitable for communication with processes such as FTP. This information level may be changed by command.

The Gateway allows a maximum of five EPSS calls to be open at any one time and it is clearly necessary to have some means of tidying up calls which are open but not being used. Calls are therefore timed out and closed if no data has passed in either direction for a period greater than the pre-set time out period. This is currently set at 5 minutes. Time outs also operate at command decoder level to deal with non replies to COP's and similar problems.

One still partly unresolved problem is caused by there being no EPSS facility for the Gateway to tell EPSS at startup to "forget everything you think you know about me" and start from scratch. I do not find the information which EPSS sends me when I come on-line about calls which it thinks I have of any use at all. It just confuses me. I try to remember what calls EPSS thinks are open so that when the initialisation dialogue is over I can close them but it does not always work.

7. Operational Considerations

Implementation of the Gateway required no changes to the standard DECsystem-10 monitor, other than some bug fixes, and the modified DN87 code drives an ANF10 remote concentrator node as well as the EPSS network port with reasonable reliability. The mean time between failures of the network software is 12 hours or greater.

There are some security questions worth mentioning here. If we allow ANF10 terminals to connect directly to the Gateway without being logged in to an ANF10 host first then we have no control over access to the EPSS network. There are two possible solutions to this problem. Either we require users to log in to the Gateway command decoder or we make them log in to a host and use EPSSER to access the Gateway. The first seems better because it keeps host overheads low but the second has the advantage that passwords and accounting files are normally kept on hosts.

There are similar considerations of resource allocation and accounting. The next version of the Gateway at Hatfield will in fact provide access control and accounting information with files held on local floppy disks. These files will be interrogated and/or updated when required by programs running on the host.

8. Future Developments

An ANF10 to PSS Gateway based on the same principles as the one described above but containing many improvements including a better command decoder, security features, accounting information logging, support for X3/X28/X29 virtual terminal protocols and support for the "blue book" FTP is now being implemented at York. The ANF10 to EPSS Gateway has been providing a service to users at Hatfield since the summer of 1978 but it has been equally useful as a pilot project for the PSS Gateway. The feasibility has been demonstrated and many lessons have been learned which will help to make the PSS Gateway a more useful and reliable product.

9. Acknowledgements

I should like to thank my colleagues at Hatfield for their help during this project, particularly Bob Stephens and Ian Service (now at York University) also Roland Rosner and John Burren of the Rutherford Laboratory for supporting a study of DECsystem-10 to public network connection and Bill Koteff of Digital Equipment Corporation at Marlboro, Mass. who has given considerable encouragement.

MDS/VRAC
29.6.79.

National Exporting Centres Group
Survey of communications monitors

Tony Peatfield
ULCC

National Exporting Centres Group

Survey of Communications Monitors

Introduction

The National Exporting Centres Group identified the need for a development aid for those users implementing corrections to an X-25 network. The network in question could be a University regional network, a rented switch or the Post Office PSS. The development aid should be capable of checking out the user's level 2 and level 3 implementation.

Such a development aid should be capable of running programmes supplied by a network management team. The user's implementation could then be validated, as much as possible, before attempts were made to connect to the network. This should relieve the central network team of much of the time-consuming work involved in aiding users at the development phase.

An adequate development aid would need to be capable of fully testing the X-25 line protocols, call set-up procedures etc. and data transfers. It should also be capable of simulating a host site to reduce the requirement for long interactive test sessions via a telephone circuit.

A development aid that is powerful enough and flexible enough to allow new programmes to be developed as new network facilities emerge will not be an inexpensive item. It is unlikely that a user will be able to obtain the necessary funding to purchase such a device in order to develop his network connection. However the advantages to be gained are great. It should be possible, after selection of a suitable instrument, to obtain central funding through the Joint Network Team for the purchase of a number of instruments for loan to users.

If a pool of such instruments was to be established then this would ensure that all users would be using a well understood common device with a common set of programmes.

The Survey

Known communications monitors were examined. These were Tektronix 832, H.P. 1640A, Halcyon 803A, Datascope 501/502, ERCC PDP-11 Based System, Tekelec TE92 and Interlekt Intershake. The principle investigation has been by means of examining the specifications and demonstrations have been arranged for some of the instruments. It is not claimed that all possible instruments have been covered.

The investigation has shown that the instruments fall into three main categories.

1. Low-Medium Speed Monitors ($<$ 48 kbps)

   (Tektronix 832, HP 1640A, Halcyon 803A)

2. Low-High Speed Monitors ($>$ 48 kbps)

   (range of Datascopes)

3. Low-High Speed Monitors and Simulators

   (ERCC PDP-11 System, Tekelec TE92, Intershake)

The Devices in 1. and 2. have some simulation facilities but they are not considered adequate for the protocol testing that will be required. They are basically monitors that are intended for lower level applications.

A short summary of each instrument, except the Tektronix 832 which was not considered worthy of inclusion, and a comparison table of features has been prepared.

TEKELEC TE92 (Wessen Electronics)

This instrument comes closest to meeting all the requirements as laid out in the table. It is the only commercially available device to come close to the requirements.

It is not clear how easy it will be to create new programs and it may be necessary to have a separate 8080 development system or cross assembler. The Post Office are concerned about this and how easy it will be to make the Transpac programs useable. However if the Post Office standardise on this unit then the PSS User Groups may be able to ensure availability of programs.

ERCC PDP-11 based system

The LSI 11/03 and Floppy version of this monitor does not have sufficient performance. A faster PDP-11 and better disc system would perform adequately. The drawbacks then would be lack of part ability and lack of system support from the supplier.

INTERLEKT Intershake

Limited by a small data buffer and the complexity of operation required. It is also bulky in that it comes in three fairly large parts (Screen/Monitor, Tape, Console/CPU).

HALCYON 803A

This device has a large range of functions which make it a strong contender for the data monitor function. The drawbacks are complexity of operation and speed limitations. It is also not possible to simulate hosts and terminals adequately.

DATASCOPE 501/502

Although the range of Datascopes have attractive features, they are not equipped to offer host or terminal simulation. Program steps are limited and program development facilities not readily available.

HEWLETT PACKARD 1640A

Speed limitations and lack of programmability make it inadequate. It should perform adequately as a medium speed line monitor.

P. Black
A.C. Peatfield
ULCC 23.3.79.

REQUIREMENT	TEKELEC TE92	INTERLECT INTERSHAKE	HALCYON 803A	DATASCOPE 501/502	H.P. 1640A	ERCC PDP-11 BASED SYSTEM
SPEED RANGE 48 kbps +	YES	YES	YES >9.6K monitor only	YES	NO	YES
TRUE FULL DUPLEX	YES	YES	YES	YES	Not established	YES
GOOD LOCAL STORAGE 4K Bytes +	YES	NO	YES	YES	NO	YES
ACCESS TO A MASS STORAGE DEVICE	YES	YES	YES	YES	YES	YES
ACCESS TO HARD COPY DEVICE	YES	YES	YES	YES	YES	YES
ABILITY TO SIMULATE HOST OR TERMINAL	YES	YES	YES	Limited	Limited	Possible to develop
CODE INTERPRETATION 'MNEMONICS'	YES	YES	YES	YES	YES	YES
TIMERS COUNTERS AND TRAPS	YES	YES	YES	YES	YES	YES
FLEXIBILITY IN TEST PROCEDURES	YES	YES	YES	YES	Limited	YES
PROGRAM LIBRARY FACILITIES	YES	YES	YES	YES	YES	YES
OPERATOR I/O SHOULD BE SIMPLE/ UNAMBIGUOUS	YES	NO	NO	NO	NO	YES
EVENTS OPTIONALLY INTERPRETED IN REALTIME	YES	YES	YES	NO	NO	YES
SHOULD BE TRANSPORTABLE	YES	YES	YES	YES	YES	NO
V-24, V-35	YES	YES	YES	YES	YES	YES
SOUND HARDWARE SUPPORT	YES	YES	YES	YES	YES	User organised
SOUND SOFTWARE SUPPORT	YES For Basic tests	YES	YES	N/A	N/A	Questionable
GOOD PROGRAM DEVELOPMENT FACILITIES	YES with special tools	NO	NO	NO	NO	YES
ALPHA NUMERIC KEYBOARDS	YES not with Basic programs	YES advantages not clear	NO	NO	NO	YES
APPROX. PRICE OF REASONABLE CONFIGURATION	£16K	£16K	£16K	£15K	£6K	£15K +

803A Specifications

Speeds	50 to 9600 bps full duplex. 50 bps to 19.2K bps half duplex. 56K bps, monitoring only, optional. Internal speeds: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, and 19,200 bps. External clock: x1 and x16, bps.
Framing	5, 6. 7 or 8-bit with or without parity bit. Synchronous: 1 or 2 sync characters (user definable) or transparent. Asynchronous: 1, 1½ or 2 stop bits.
Codes	ASCII, EBCDIC, Baudot, 2740/41 Selectric, and hex. Others optional.
Protocols	Asynchronous and synchronous byte-controlled (BSC or similar protocols). Synchronous bit-oriented (SDLC, HDLC, and ADCCP) optional.
Interfaces	RS-232-C/V.24 and current loop (20 /40, 20 /60, or 40 /60 mA).
Interface Test Points	21 plus ground, metallic on front panel.
Interface Display	21 tristate LEDs: Mark = red, Space = green, Inactive = off.
External Input (Transition detector)	Front panel, interface compatible.
CRT Display	5-inch diagonal, 256 characters, 32 characters per line.
Display Modes	Time multiplex, line multiplex, and split screen.
Instruction Set	61 macro-instructions, expandable to 99.
Program Entry	Built-in hexadecimal keyboard plus 24 special-function keys.
Program Buffer	1024 bytes non-volatile RAM, expandable to 4096 bytes.
Capture Buffer	4096 bytes RAM (2048 data, 2048 interface lead status), expandable to 8192 bytes.
Message Buffer	512 bytes RAM, including BCC.
Programmable Counters	10 counters, up to 255 counts each.
Trapping Capability	Trap on EIA lead status, character pattern, or errors.
Timing Measurements	Turnaround time, elapsed time, and EIA lead intervals.
Timing Range	1 ms to 9.9 min. ± 1 ms.
Delay Generation	Selectable in ms or sec.
Block Check Characters	VRC/LRC, CRC-16, and CRC-CCITT. Others optional.
ROM Monitoring Programs	Asynchronous, Synchronous, BCP and BOP.
ROM Traffic Messages	Fox and 511 bit pattern.
Auxiliary Outputs	Composite video and asychronous remote RS-232-C.
External Printer Capability	Asynchronous, ASCII.
Operating Environment	Temperature: 0° C to 50° C. Humidity: 0 to 90%.
Size	Height: 7 in. (17.78 cm). Depth: 19.5 in. (49.5 cm). Width, 803A: 13 in. (33 cm). Width, 803A/803A-T: 17 in. (43.2 cm).
Weight	37 lbs (16.8 kg).
Power	100, 115/120, 220, 230/240 Vac, 50/60 Hz; 150 VA.

803A-T Specifications

Tape Configuration	Mini-cassette.
Tape Head	Single-channel read/write.
Data Density	800 bits per inch.
Data Capacity	60K bytes or 96K bytes per side, unformatted (50 or 80 ft of tape on mini-cassette).
Data Transfer Rate	2400 bps.
Tape Error Rate	<1 in 10^7 bits.
Weight (803A/803A-T)	39 lbs (17.7 kg).

HEWLETT PACKARD

SPECIFICATIONS 1640A

Note: Specifications describe the instrument's warranted performance. Supplemental Characteristics provide information useful for applying the instrument by giving non-warranted operating parameters.

INPUTS

IMPEDANCE: >30KΩ on all interface connections except ground.
CONNECTOR: mates with RS-232C (V24) interfaces.

FORMAT

FRAMING: 5,6,7 or 8 information bits with or without a parity bit.
DATA CODES: ASCII, Hex or EBCDIC. Other optional code sets in addition to or in lieu of EBCDIC are available.

DATA MODES
Asynchronous: 1 or 2 stop bits in addition to information and parity bits.
Synchronous: 1 or 2 user-entered synchronizing characters. Sync search may be initiated on a user-entered character immediately followed by a user-entered number of idle characters from 0 to 99. Idle is defined as a steady mark (logic 1's) in all bit positions.

SPEED
External Clock (Synchronous)

CHARACTER SIZE INCLUDING PARITY (bits)	NORMAL OPERATION Bits Per Second		HIGH SPEED MODE* Bits Per Second	
	HDX	FDX	HDX	FDX
9	19200	9600	19200	9600
8	14400	7200	19200	9600
7	14400	7200	19200	9600
6	9600	6400	14400	7200
5	9600	4800	9600	7200

*Memory data is not displayed while a run is in progress. High speed switch located on rear of Patch Panel Matrix.

Internal Clock (Asynchronous): 50, 75, 110, 134.5, 150, 200, 300, 400, 600, 900, 1200, 1800, 2400, 4800, and 9600 bps ±1%. Also any external X1 clock to a maximum of 9600 bps may be used for asynchronous operation.

Note: asynchronous operation follows the same speed vs character specification as synchronous operation.

Optional Accessories

INTERSHAKE II (DTM-2-1) Options

- Option 14C, Rack-Mount Kit
  CAE-22-10 EIA Cable (10 ft)
- Option 24-5, 56 Kbps High Speed Crystal
- Option 24-(), Standard High Speed Crystal, 1 = 19.2, 2 = 40.8, 3 = 48.0, 4 = 50.0 and 6 = 64.0 Kbps
- Option 25, Non-Standard High Speed Crystal, up to 64 Kbps
- Option 23-2, Six-Position Crystal Oscillator Speed Switch. Highspeed crystals not included.
  Standard Stored Test PROMS
  Standard Message PROM
- Option 13-1-2, Special "Stored Test" PROM Set
- Option 13-2-2, Special "Message" PROM
- Option 13-3-2, EBCDIC 3270 PROM Set
- Option 13-4-2, ASCII 3270 PROM Set
- Option 13-5-2, ASCII/EBCDIC 3270 PROM Set
- Option 13-6-2, EBCDIC 3270 "G" PROM
- M548, Mil Std 188 Modification
- M550, 1024 Stop Program Cell Modification
- Option 07, Loop Interface
- Option 16, 230V/50Hz Compatibility
- Option 90, Upgrade INTERSHAKE II Series "A" thru "F" to Series "H"
- Option 40-1-2, Inter-KEY Keyboard, Portable
- Option 40-2-2, Inter-KEY Keyboard, Rack-Mount
  Operator's Manual
  Operator's Guide
- 37401, Padded Travel Bag for DTM-2-1 without Option 40
- 37405, Padded Travel Bag for DTM-2-1 with Option 40

Peripheral Options

- Option 18-7-2, INTERVIEW I, Portable
- Option 18-8-2, INTERVIEW I, Rack-Mount
  DTM-2/INTERVIEW Cable
- SCM-1-1, Converter Module INTERVIEW I to INTERVIEW II, SAM-1-1
- SCM-2-1, Converter Module INTERVIEW I to INTERVIEW II, SAM-2-1
  Optional Speeds in SCM Positions A, B and C
  Ribbon Cable "TEE" Type (6 ft)
- CRT Option 1, Code Position A, B = BCD, REV BCD
- CRT Option 2, Code Position A, B = BCD, REV EBCD
- CRT Option 3, Code Position A, B = BAUDOT/ITA No. 2, Field Data
- CRT Option 4, Code Position A, B = BAUDOT/ITA No. 2 REV BCD
- CRT Option 5, Code Position A, B = IPARS/ITA No. 2
  Non-Standard Codes in positions A and B
- 37402, Padded Travel Bag for INTERVIEW I or II
- ITU-1-2, INTERTAPE, Desk Model
- ITU-2-2, INTERTAPE, Portable with Rack-Mount Kit
  Operator's Manual
  Power Cord
  DTM-2 INTERTAPE Cable
- Tape Option 1, speed position ABC = 900, 3600, 7200 bps
- Tape Option 2, speed position ABC = 1000, 1050, 2000 bps
- Tape Option 3, speed position ABC = 1000, 2000, 3600 bps
- Tape Option 4, speed position ABC = 2000, 3600, 7200 bps
- Tape Option 5, speed position D = 19.2 Kbps
  Non-Standard speeds in position ABC
  Non-Standard speed in position D
- 34129, 30 Additional Data Cartridge Labels for ITU-1
- 25650, Additional Data Cartridge for ITU
- 37407, Padded Travel Bag for ITU-1
- 37406, Padded Travel Bag for ITU-2
- Option 17-1-2, Cassette Recorder, Portable with Rack-Mount Kit
- Option 08-1-2, Printer, Portable
- Option 08-2-2, Printer, Rack-Mount
  Operator's Manual

Accessory Options

- Option 19-2, Auxiliary Interface open-end cable
- Option 20-2, Auxiliary Interface "Y" cable
- Option 21-2, Spare Cable, INTERSHAKE II to INTERVIEW
- Option 22-2, 801C Auxiliary Interface "H" cable
- IFA-2/IFA-3, High Speed Adapters, RS-232/V.24 to/from WECO 303
  230V/50Hz Version of IFA-2/IFA-3
- IFA-4/IFA-5-1, High Speed Adapters, RS-232/V.24 to/from V.35
- IFA-4-2/IFA-5-2, 230V/50Hz version of IFA-4-1/IFA-5-1
- 34480, Carrying Case for IFA-2/IFA-3 or IFA-4/IFA-5

INTERSHAKE Test System Specifications

Interface (serial)

RS-232/V.24 - 2 connectors allow the INTERSHAKE to be cabled in series with the circuit (between the modem and terminal/CPU) for the utmost versatility in monitoring or emulation.

Interface (parallel)

Seven of the RS-232 control leads may be programmably activated or sensed by the user. TTL logic signals are available as a parallel datapoint for transmit or receive.

Data Rate

15 fixed speeds: 50, 75, 110, 134.5, 150, 300, 600, 900, 1200, 1800, 2400, 3600, 4800, 7200, 9600 bps. Internal oscillator: variable from 45-2400 bps. Internal high speed crystal: variable from 19.2 to 64 Kbps. With external clock: 64 to 256 Kbps.

Data Format

Sync, Async, SDLC. Receiver syncs with 0, 1, 2 sync characters.

Character Size

5, 6, 7 and 8 information bits plus parity bit.

Error Checks

Real time calculation for transmit and receive:
Character parity - EVEN, ODD, NONE,
LRC - 6, 7, 8 bits - EVEN, OFF,
CRC - SDLC, bisync and four (4) others - normal, inverted.

Error Rate Measurements

Up to 999 counts of errors: parity, LRC, CRC.
Base count: 10-10^8 sequences.

EIA Status Indicators

Twenty-three (23) LED indicators: 4 are tri-state (2, 3, 15, 17) - red-space/green-mark/no light-open line.

Full Duplex/Half Duplex

The INTERSHAKE Test System can operate in Full Duplex or Half Duplex modes.

Setup

On-line monitor setup can be set by panel switch or by program instruction.

Protocols

The INTERSHAKE Test System is virtually compatible with all line protocols.

Programming

Program is alphanumeric or HEX using high level INTERSHAKE language.

Program Progress

Current step executing is displayed during progress of program.

Print Program

Hard copy of programs can be made on any ASCII printer, CRT or I/O device that has an RS-232/V.24 Interface.

Program Memory

Each user program instruction function placed in program memory is executed in one step. A single Function/Step is equivalent to 5-12 bytes of memory in a conventional microprocessor.

User Program Memory

2048 program steps are accessible at the unit. This is an equivalent of 10K to 24K bytes of microprocessor memory. The 2048 user program steps are available as presented below:

Alterable program memory

Non-volatile RAM of 1024 steps configured in 8 cells of 128 steps each, or 4 cells of 256 steps each. Immediate access for program construction and editing. Program memory supported by battery to retain program when power is off.

Stored program memory

Erasable PROM (EPROM) of 1024 steps configured in 8 cells of 128 steps each, or 4 cells of 256 steps each. These firmware programs can be temporarily edited by the operator.

Canned message memory

Erasable PROM (EPROM) of 1024 characters configured in eight messages of up to 127 characters each.

External Program Library Source

Store on serial async ASCII device up to 9600bps, e.g., Silent 700, ASR 33, etc.

Program memory from another "like" unit

Programs can be transferred from one INTERSHAKE to another, remotely as well as locally.

Cassette

Any async ASCII cassette can store an INTERSHAKE program for later remote or local transfer to an INTERSHAKE unit.

Capture Memory

2048 characters of buffer and CRT capture for recording test progress, test results and other data.

Buffer Capture

RAM of 1024 characters. Selective capture under Program Control.

CRT Capture

CRT capture and display of 1024 characters is selective and independent of the captive memory.

Buffer Output

Transmit contents of 1024 character capture buffer entirely or selectively under program control. Transmits receive data, frequency readings, program progress markers, counter readings, duration data and interface status.

Translate buffer output

Translate any or all contents of capture buffer to other languages (and HEX) for transmission.

Counting and Timing

Can measure time, frequency or number of events.
Display is constantly updated and always visible.
Can record up to 1024 readings into captive memory under program control.

Data Display

Large 9-inch, 1024 character CRT display. Displays 1024 characters (16 lines of 64 characters) or 512 characters (16 lines of 32 characters).

Program Instruction Functions

There are over 100 basic "one-step" instructions. Instructions are provided for all aspects of program path control, such as Start/Stop, Interim Stop, Restart, Jump, Loop and Program Path Change. INTERSHAKE is also capable of jumping to subroutine and returning to specified location.

Data Inversion

Single switch selects EIA or MIL 188 type operation.

Data Synchronization

Forced sync - through program.
Auto sync - tells the unit what characters to sync on. Acts as idle suppress.

Power

115V, 60 Hz, 1 Amp.
230V, 50 Hz (Optional)

Physical Dimensions

INTERSHAKE II
- Portable:
  20 inches (50.8 cm) wide, 15.5 inches (39.4 cm) deep, 7 inches (17.8 cm) high.
- Rack mounted:
  19 inches (48.2 cm) wide, 13 inches (33.0 cm) deep, 12-¾ inches (32.3 cm) high.

INTERSHAKE II/Inter-KEY:
- Portable:
  20-½ inches (52.0 cm) wide, 19-½ inches (49.5 cm) deep, 8-¼ inches (21.0 cm) high.
- Rack mounted:
  - INTERSHAKE II - 19 inches (48.2 cm) wide, 18 inches (45.7 cm) deep, 12-¾ inches (32.3 cm) high.
  - Inter-KEY - 18-¾ inches (47.6 cm) wide, 8 inches (20.3 cm) deep, 3 inches (7.6 cm) high.

Weight

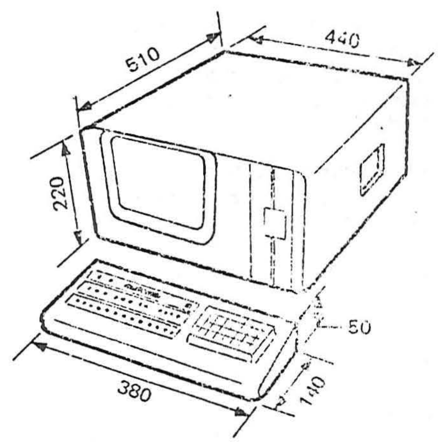
INTERSHAKE II
- Portable: 38 pounds (17.3 kg).

INTERSHAKE II/Inter-KEY:
- Portable: 45 pounds (20.4 kg).
- Rack mounted:
  - INTERSHAKE II - 28.4 pounds (12.9 kg).
  - Inter-KEY keyboard (with cable) - 6 pounds (2.7 kg).

Specifications may change as design improvements are introduced.

Functions	• Analyzer • Simulator. • Junctions survey and monitoring • Data rate measurement
Connection to the network	• On-line or Off-line.
Data rate	• From 0 to 72 kbit/s in both directions of transmission.
Junctions	• V 24/28, V 35/36
Couplers	• HDLC, ECMA 24, BSC, Binary.
Data memory	• RAM : 16 kilobytes ; Mass storage : diskette 80 kilobytes.
Program memory	• REPROM : 16 kilobytes ; diskette ; 80 kilobytes
Keyboard	• Extended 20-key hexadecimal keyboard.
I/O interface	• Teleprinter, 50 - 9600 baud. • High speed paper tape reader • Video output : 75 Ω, 0, + 4 V, 625-lines
CRT display	• 225 mm diagonal screen 16-lines of 62-characters, character size 7 x 9.
Software library	• Dialogue with the operator (yes, no, value, =) permits the TE 92 to be used as an analyzer or as a simulator, with procedures HDLC, BSC, for a data rate of ..., and with a junction V 24 or..., etc... • Analysis : binary, HDLC, BSC, ECMA, CRC computation, display of flag number between frames, synchronized acquisition " from " or " up to " in circulating memory or page per page. Analytical display (X 25) or direct display in binary, double hexadecimal or ASCII modes. • Simulation : ETTD type (terminal), ETCD type (network), data rate, error injection, junction monitoring, caller or X 25-network simulation.
Options	• Extended data memory (+ 16 kilobytes) permits continuous diskette recording up to 64 kilobytes. • Extra diskette (file management, etc...) • Development of other program library such as : " analytical analysis and simulation ", or other procedures (please contact us)
Power supply	• 220 VAC ± 10 %, 50 Hz, 300 VA (The instrument is powered by a switching power supply developed by TEKELEC)..
Dimensions and weight	• 19" rack-mounting cabinet, 5 U-H x 500 mm D, equipped with two splash-proof covers. Removable keyboard. • Weight : 15 kg

- Qualification of terminal.
- Development of terminals
- Checking of data flow in both directions of transmission.
- Development of data transmission procedures (line level)
- Development of data transmission protocols (network level)
- Testing terminals (hardware and software) before connection to the network.
- Testing local or remote modems by telelock.
- Testing network using X 25 protocol
- Endless recording (circulating memory)
- Data transmission network survey.



Dimensions in mm

SUMMARY SPECIFICATIONS

Features and Options	D-501B	D-502B
†Speed	Up to 100 Kbps	Same
Programmable	18 Instructions	19 Instructions
Program Entry	Hexadecimal Keyboard	Same
Standard Buffer	2,000 characters each side of line	Same
** †Expanded Buffer	4,000 characters each side of line	Same
†Rerun Program on Buffer Contents	Standard	Standard
†Program Steps	69	Same
** †CRC/LRC Calculate	Calculate CRC, LRC, & BCC with character delete ability	Calculate & Generate
†Instruction Edit	Standard	Standard
Time-correlated FDX display	Standard	Standard
Interactive	Not Available	Standard
Program Load/Unload	Not Available	Standard
Output Buffer	Not Available	300 Characters
2-character Sync	Standard	Standard
** †Accessory Adapter	Permits attachment of tape and keyboard accessories	Same
Codes	Hex, ASCII, EBCDIC (2 more optional)	Same
Interface	RS-232*	RS-232*
Event Mark	Standard	Standard
Event Counters	4 Program Controlled/each counts to 9,999	Same
Timers	4 Program Controlled/each times to 60.000 sec.	Same
Screen	5-inch CRT; 375 characters on 15 lines of 25 each	Same
Framing	5 to 8-bit sync or async and SDLC	Same
Display Modes	Send, Rcv, HDX-2, HDX-4, FDX	Same
Markers	Parity, Carrier, RTS, Event	Same
Idle Suppress	Mark, Space or Sync	Same
Data Polarity Control	Standard	Standard
Interface Display	ALL EIA leads except 1, 7, 9, 10	Same
Interface Test Points	ALL EIA leads	Same
External Event Input	Standard	Standard
†Video Output	Standard	Standard
Size	5-1/4" high x 16" wide x 17" deep	Same
Weight	25 pounds	Same
Power	120/240 VAC, 50/60 hz, 120 watts	Same

† New features or enhancements
* Speeds above 19.2 KBPS require separate connecting unit.
** Option at extra charge

OPTIONS AND ACCESSORIES

Human language alphabets: XS-3, IPARS, Baudot, Padded Baudot, IBM 2741, and BCD Code. Other character sets on special order.
High Speed Tape Unit (T-511)
Remote Connection Units for RS-232, CCITT V.35, 303 Wideband and telegraph current loop interfaces.
T-Connector, Model TC-3

Video Monitor for Remote Display
Rack Mounting with Slides, RA-501
Freight Shipping Case, TC-501
ASCII/EBCDIC Keyboard
Digital Tape Unit, Model T-96
Program Storage Adapter
Cassette Recorder

Transport level addressing

Peter Girard
Rutherford Laboratory

TRANSPORT LEVEL ADDRESSING

1. Introduction

The paper is partly an exposition of the addressing scheme contained in the SG3 Transport Service, and partly a discussion of how the basic scheme might be put into practice.

2. PSS Numbering Scheme

PSS will be linked to other PTT networks, but the PSS numbering scheme makes this completely invisible to the customer. Hence the whole collection of interlinked PTT networks looks like a single X25 network, from an addressing point of view.

The PSS Numbering Scheme thus belongs essentially to Level 3. The SG3 addressing proposals belong to Level 4, so there is no conflict between the two schemes.

3. Need for Level 4 Addressing

DTE's connected to PSS may be gateways into private networks, or even into private multi-network systems within a single organisation. The two optional sub-address digits provided by PSS are quite inadequate to cope with the addressing problems occuring in such situations, which may well be quite common.

In any case, a solution is needed where only private networks are being interconnected, and PSS sub-address digits do not arise then of course.

Thus, an addressing scheme is needed capable of coping with any multi-network system. Each component network (including PSS if applicable) will have its own Level 3 numbering scheme: to link them together we need a Level 4 mechanism.

4. The Level 4 Addressing Scheme

To establish a "connection" across a multi-network system, a "connection request" must be issued by the calling end. This must find its way acrss any intervening Level 3 networks, by causing a "call" to be set up across each network in turn.

In the SG3 proposal, the connection request takes the form of a Transport Service "CONNECT message" containing two main parameters known as the "called address" and the "calling address". As far as any intervening Level 3 networks are concerned, the CONNECT message is carried essentially as data:

in the X25 case it therefore appears in the CUDF, overflowing into subsequent packets as necessary. Gateways between Level 3 networks must have at least a rudimentary Level 4, so that they can understand and manipulate Level 4 addresses. A gateway and a transport station are logically identical from an addressing point of view, and the term gateway may therefore be conveniently used for both.

Level 4 addressing appears also in ACCEPT, DISCONNECT and RESET messages. However, the principles for handling them are the same as in CONNECT messages.

5. Naming Authorities and Domains

A "domain" is the region over which a "naming authority" has jurisdiction, and can range from a single computer at one extreme to a collection of complete networks at the other.

The basic assumption is that it is impossible to set up suddenly a single centralised naming authority covering all present and future networks. New networks or collections of networks are likely to come onto the scene already having de facto naming authorities of their own.

Hence the requirements to be satisfied by a Level 4 addressing scheme are as follows. It must allow interworking between different domains, and it must facilitate a gradual rationalisation and centralisation of names by making it easy for domains to be merged together as necessary.

6. Single-Network Domains

The SG3 scheme takes its simplest form when each domain corresponds to one Level 3 network. The "called address" and "calling address" each take the form of an explicit route specification: a succession of gateway names. Each gateway transforms the "called address" by removing its own name from the front, and the "calling address" by adding the name of the previous gateway to the front. Each name (except the last) has a terminator which the gateway concerned must be able to recognise as such.

7. Multi-Network Domains

If the transformation to be applied to the "called address" is looked up in a table rather than taking the specific form described above, then the gateway code can handle multi-network domains. The transformation for single-network domains becomes a particular case of something more general.

The gateway is interested only in the first field of the "called address". It applies a transformation to this, but passes the rest of the "called address" through transparently. It adds the name of the previous gateway to the front of the calling address.

The diagram illustrates a possible transformation table. The null entries imply simple deletion of the field, and correspond to the case of single network domains. Transformations may be arbitrarily complex; the only requirement is that the next gateway is presented with something that it can understand.

8. Choice of names

There are two types of name. The first type is called a "title" and is an arbitrarily chosen string of characters. The other type is an explicit address, which implies a particular location in the network.

Titles are convenient from a user's point of view because they can be short mnemonics, they are invariant to changes of configuration, they allow multi-network domains, and they may even offer a choice of routes across such domains. On the other hand they must be built into tables and consequently require storage space, and effort to keep the tables up to date. In a small machine, there may be space to store only the most frequently used titles.

Explicit addresses are needed as well as titles. These are self-defining and require no table space. The most obvious way of assigning explicit addresses is to make them equal to Level 3 DTE numbers. They will then be numeric (in an X25 context), and valid within a single network. They also transform in the standard way: the gateway simply removes them from the front of the "called address" for instance.

The diagram gives some examples of CONNECT parameters in two equivalent forms. As previously remarked, the current gateway is interested only in the first field: the rest is simply forwarded.

A simple way of distinguishing between titles and names is to insist on titles beginning with an alphabetic character.

9. Relation to PSS

In effect, the Post Office has defined only explicit addresses in its own domain. There will be no PSS titles.

10. Conclusion

The scheme is flexible, and can be used in as simple or as complex a manner as circumstances require. In the simplest case, where a straightforward DTE is communicating across one network, the Level 4 addressing may reduce right down to nothing. It is important, however, to realise that this Level of addressing is always logically present.

TS (or GATEWAY) TABLE

TITLE	ADDRESS (DTE)	TRANSFORMATION
G1	0005	—
H4	0123	—
ABCD	0013	ABCD
ELEC	0001	ITP
XYZ	0998	QRS.123

NAMES → TITLES

NAMES → (EXPLICIT) ADDRESSES

G1.Z.Q ≡ 0005.Z.Q

H4.ITP ≡ 0123.ITP

ABCD.QWERT.12 ≡ 0013.ABCD.QWERT.12

ELEC ≡ 0001.ITP

XYZ.QWERT ≡ 0998.QRS.123.QWERT

A local network based on the table ronde communication system

Brian Wood
CAP

A LOCAL NETWORK

BASED ON THE

TABLE RONDE COMMUNICATION SYSTEM

Background Notes

5 JUNE 1979

B M WOOD
CAP (London) Ltd.

1. SYSTEM STRUCTURE

- Extract from Study Report

2. SYSTEM STRUCTURE

2.1 General Principles

The Network System will provide:

- reliable, error free communication between programs in network computers;
- communication between network terminals and programs in network computers and between network terminals themselves;
- common file storage, retrieval and spooling services for programs in network computers.

The implementation minimises the problems of linking computers into the system by supporting a V24 compatible interface which can be used for simple half duplex communication through hardware and software which is standard for the computer involved. However the implementation allows for the use of more general purpose interfacing facilities and for the long term growth of the system in terms of size and data transfer capacity.

The design of the system follows well-established data communication techniques adapted and simplified for use in a local system. In particular:

- the system is organised into a series of functional layers such that the operation of lower level functions are transparent to those at higher levels. For example, operation of the basic transmission system can be changed without affecting either the application program interface or the control of logical connections.
- the system is based upon a general purpose interconnection facility allowing for multiplexing of data streams to and from attached computers; simplified interfaces are then provided through this general purpose facility.

The subsections that follow identify the physical components which make up the system (2.2 Physical Structure), and describe the system organisation in terms of the function layers (2.3 Logical Structure).

2.2 Physical Structure

The Network System comprises a set of work stations interconnected by a Communications Subsystem. The initial configuration is shown in Figure 2.2.1.

A work station may be:

- a server computer which provides one or more common services to other work stations on the network. It must be able to support a number of connections through the network at the same time, and these connections may be on behalf of different services within the computer. The initial system will have one server computer, a CTL Modular 1, providing central filing and spooling services and communications system support services

- a user computer which requires access to the communications subsystem for file transfer to and from the file server or to and from other user computers, and for terminal access. It supports only one connection at a time, operating in half-duplex mode, and can operate through a serial line driver which is standard for the system involved.

- Teletype - compatible terminals which are provided with the facility to set up half-duplex connections, normally for terminal access to a remote user computer.

The Communication Subsystem comprises:

- a set of network interface modules (NIMs) connected in a ring configuration by serial transmission links. Transmission round the ring is unidirectional, at up to 50K baud. The interface to a network interface module will normally be via a V24 interface.

  A network interface module normally comprises a communicator which controls transmission and a serial node which provides the connection between a V24 interface and the basic communicator parallel interface.

- a Communications System Manager (CSM) which is linked to one network interface module. This supports the setting up of connections through the system and monitors its operation. The CSM is not necessary for the transmission of data.

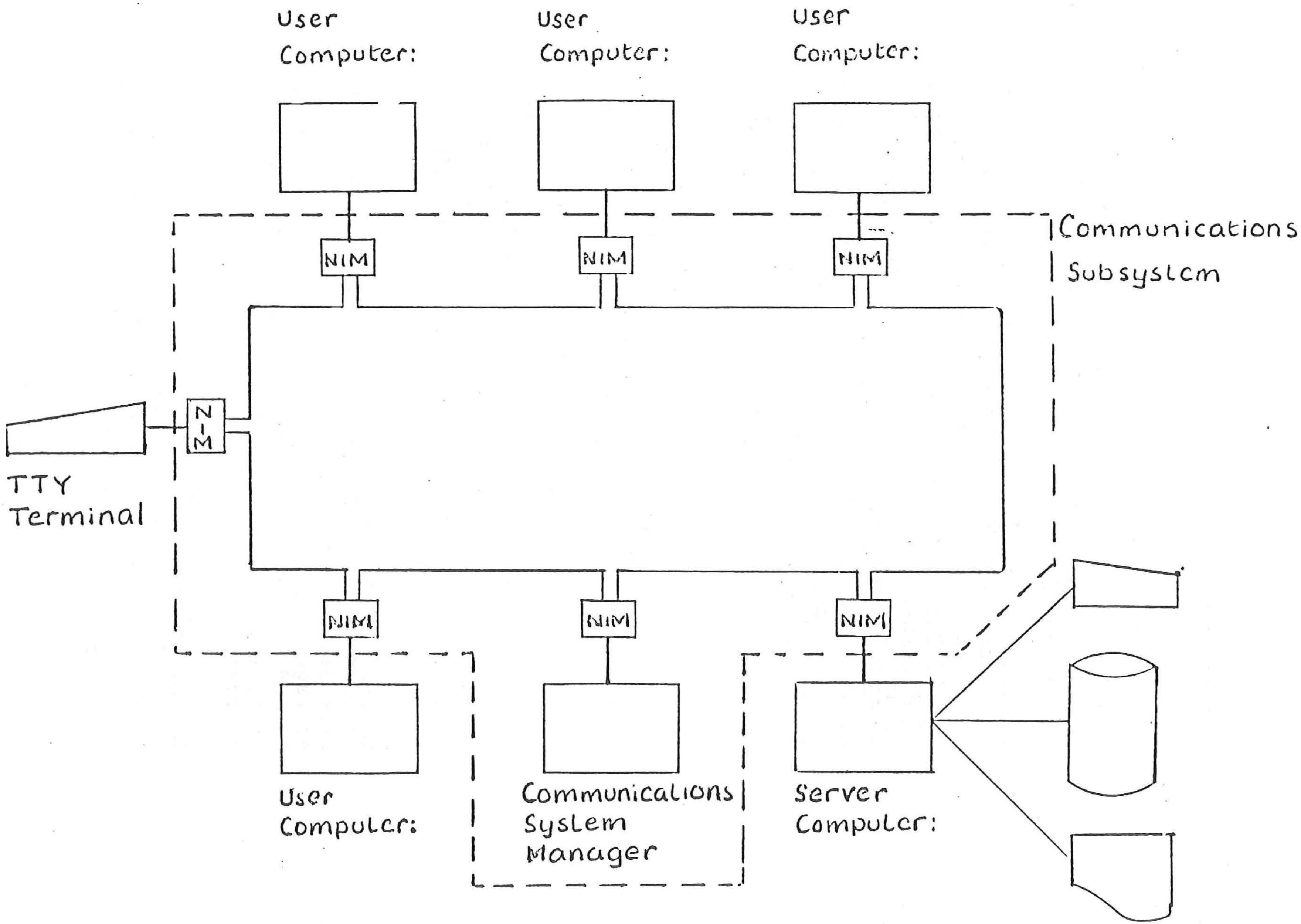


Figure 2.2.1
The Network System

2.3 Logical Structure

2.3.1 General principles

Logically the system is defined in terms of applications which communicate through a Transport Service. (Figure 2.3.1)

An application is a program or group of programs in a computer work station or the activity of a human operator for a terminal work station. The Transport Service provides for the exchange of messages between applications on the basis of logical network identifiers. Control of sequences of logically related messages is established by setting up virtual calls between applications. The application level data in a message is transferred unchanged by the Transport Service and the size of the message is determined by the buffer size agreed by the applications.

The level of implementation of the Transport Service functions depends upon the work station involved. In a server computer functions are provided through a Transport Station which can support a number of simultaneous virtual calls for a number of applications. In a user computer a specific transport handler is provided to support the specific level of function required by a specific application. For a TTY terminal a minimal level of function is provided directly by the network interface module.

Applications in server computers are the File Services and the Supervisor Services. The File Services provide a set of common data storage facilities together with spooling services to and from special peripherals. The Supervisor services provide for control of system operation.

Applications in user computers are programs which write to, or read from the File Server, programs for the transfer of data between user computers, and programs providing terminal services.

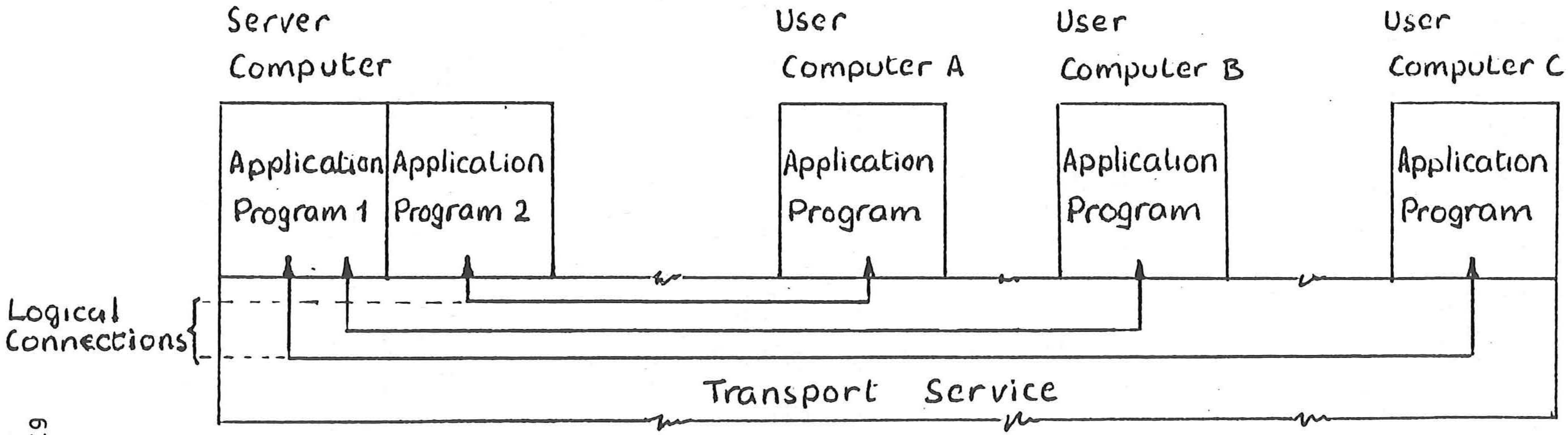


Figure 2.3.1

Network System: Logical Structure

2.3.2 Transport Services

The Transport Services are provided by the Communications Subsystem and, where computer work stations are concerned, communications software in the work station itself. Application programs in computer work stations use the Transport Services via the set of functions which comprise the applications interface; support of teletype work stations is compatible with a subset of the application interface functions.

This section is in three parts. First, it describes the logical organisation of the Transport Services; then it defines the functions which comprise the application interface; finally it describes how the three types of work station (server computer, user computer, and teletype terminal) are supported.

2.3.2.1 The logical organisation of the Transport Services

The operation of the Transport Services can be defined in terms of three levels of function (Figure 2.3.2):

- the Transport Control level,
- the Network Control level,
- the Transmission Service level.

The Transport Control functions control the setting up of virtual calls and the exchange of messages between application programs. They use the Network Control functions which control the interface to the Transmission Services and the transfer between network end-points of data messages passed from the Transport level.

The Transmission Service functions provide for the start-up of network end-points and for the reliable transmission of data blocks between them.

The Transport Control and Network Control functions are divided between the work station and the serial node for computer work stations but are, effectively, located in the serial node for teletype work stations. The Transmission Service functions are implemented in the Table Ronde communicators.

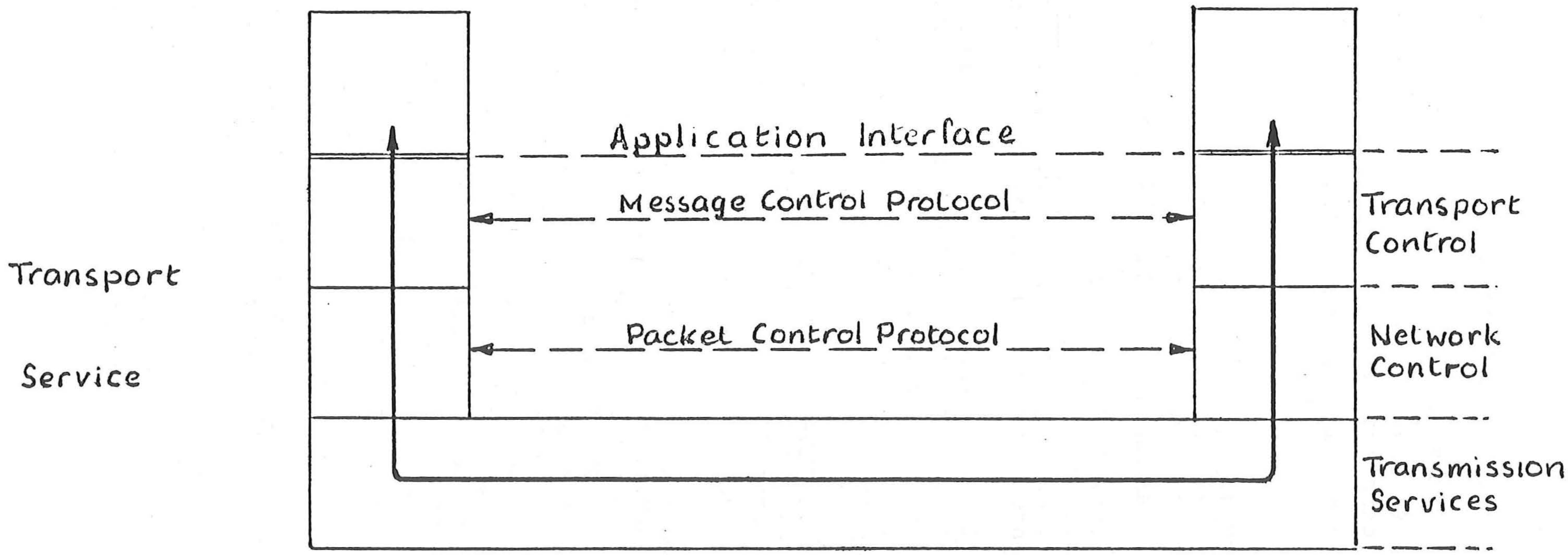


Figure 2.3.2
Transport Service: Logical Structure

2.3.2.1.1 Transport Control

The Transport Control functions provide:

- virtual call set up and clear down,
- transfer of data messages on established connections,
- control of message flow on established connections.

Virtual calls. A virtual call establishes a logical connection between two work stations. The connection is identified at each end by a logical channel number assigned by the local Transport Control functions. A message on an established connection is routed to its destination using the network address of the destination work station and the logical channel number assigned by it to the connection.

Call set up (Figure 2.3.3) Call set up depends upon actions both by the Transport Control functions local to work stations involved and by functions of the Communications System Manager.

The Communications System Manager is located at a fixed network address and provides directory services for transport control together with logging facilities for calls and for errors.

Invocation of the LISTEN function by an application program results in the assignment of a logical channel and the dispatch of a CALL REQUEST message to the Communications System Manager. The message carries the logical network identifier of the source program, the logical channel number, and, if specified by the application program, the logical network identifier with which the connection is expected. Invocation of the CONNECT function by an application program results in the same actions but the CALL REQUEST message will always carry the logical network identifier specified in the CONNECT function.

The Communications System Manager responds to a CALL REQUEST message with a STATUS message if the specified destination is inactive or connected, otherwise the request is held until it can be matched with another request. When two CALL REQUEST's are matched a CALL ACCEPT message is returned to source of the first

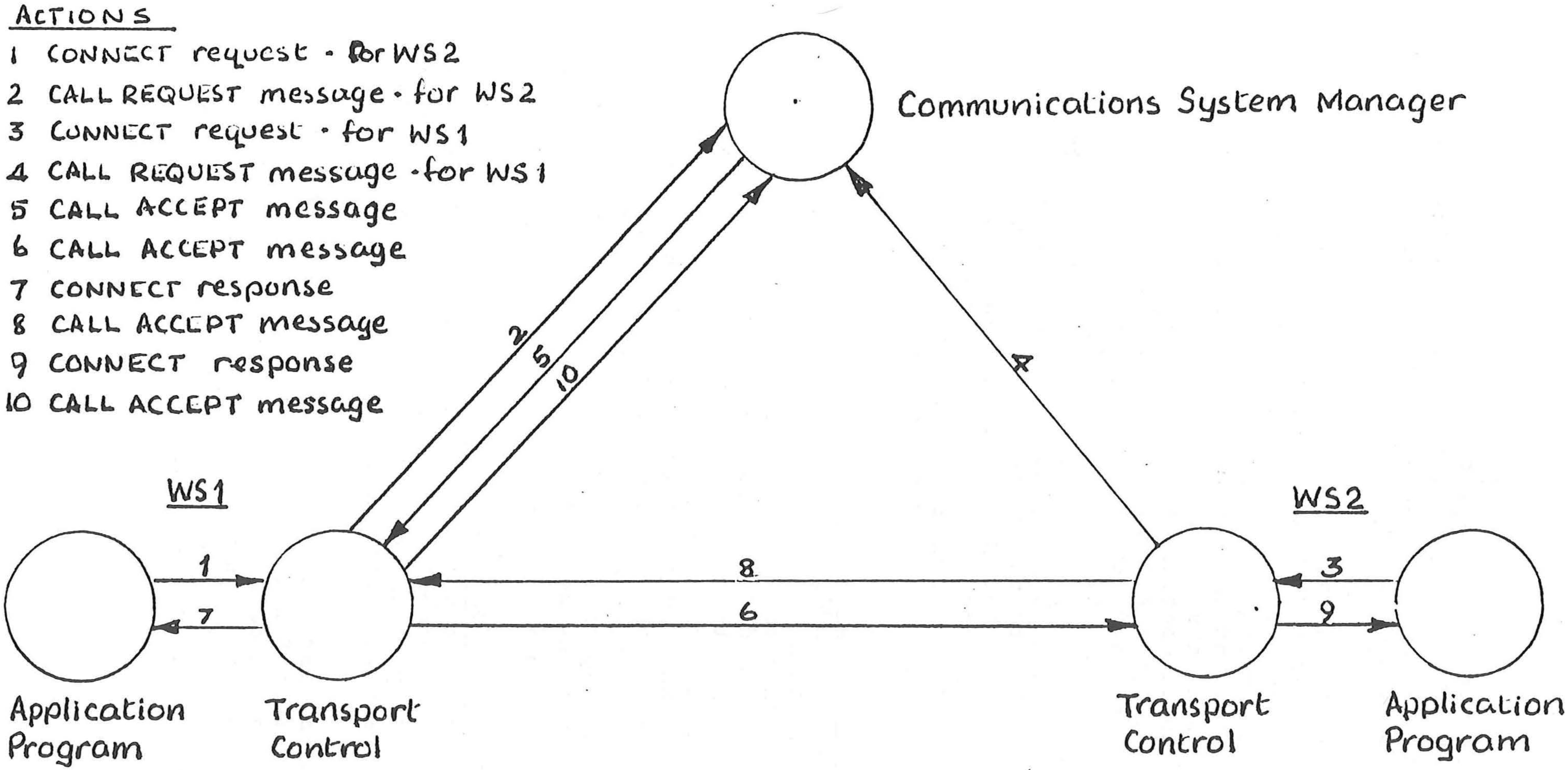


Figure 2.3.3
Virtual Call Set-up

message. This message carries the logical network identifiers, network addresses and logical channel numbers identifying each end of the connection.

When the local Transport Control function receives a CALL ACCEPT message it identifies the local channel. If the channel is in the calling state it is set into the connected state, and the remote network address and logical channel number are stored with the channel control information, a connected status is returned to the application program,and the CALL ACCEPT message is sent on to the remote address. When the channel is in the connected state all messages other than DATA,SERVICE, or CLEAR messages are rejected to the Communication System Manager. Thus the CALL ACCEPT message is exchanged by the Transport control functions at the two ends of the connection and then returned to the Communications System Manager.

<u>Call clearing</u> (Figure 2.3.4) Invocation of the DISCONNECT function by the application program at either end of a call results in the dispatch of a CALL CLEAR message to the remote end of the call and to the Communications System Manager, and in the release of the logical channel assigned to the call. Receipt of a CALL CLEAR message by the Transport Control functions results in a status return to the application program, the dispatch of the CALL CLEAR message to the Communications System Manager, and the release of the logical channel assigned to the call.

<u>Data transfer and flow control</u>: An application program requests the sending of a DATA message over a connection by invoking the PUT function specifying the channel number and the address of a buffer containing the message.

A program allows the receipt of a DATA message by specifying a buffer in which to receive it: this can be done either through an additional parameter on the PUT or by an invocation of the GET function specifying the channel number and the input buffer address.

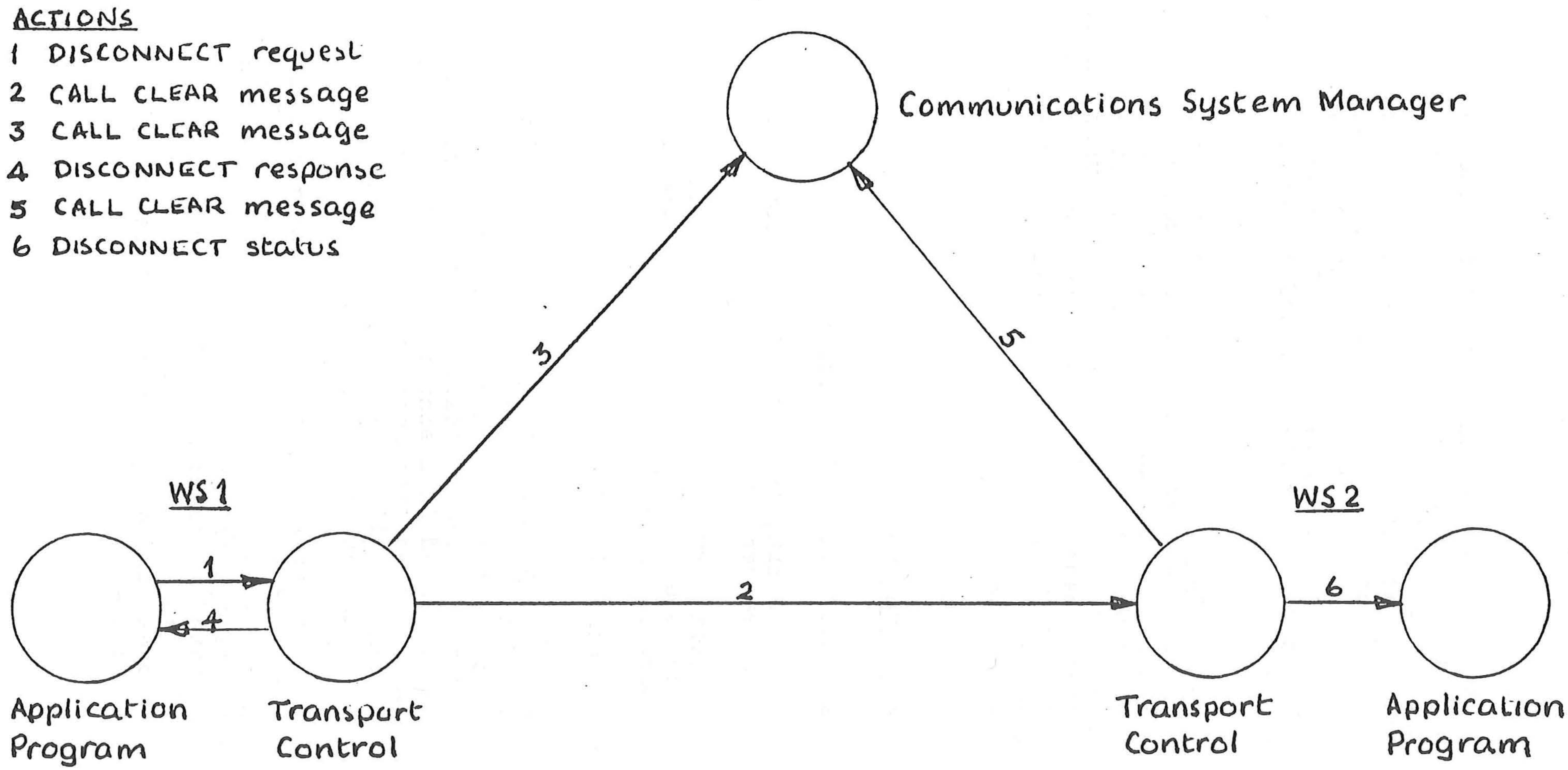


Figure 2.3.4
Virtual Call Clear-down

A DATA message header contains a sequence number and a receive buffer count which specifies the number of input buffers assigned at the sending end since the last message sent by it. If there is no DATA message to be sent or the sending of a DATA message is not allowed, a SERVICE message will be sent to convey the buffer receive count.

Invalid messages. A message can be invalid because it has an invalid code, because it has a code which is invalid for the state of the channel, because it is out of order etc. Invalid messages are sent to the Communications System Manager if necessary with explanations information appended. On a established call some invalid messages may cause the call to be disconnected.

2.3.2.1.2 Network Control

The Network control functions provide:

- message fragmentation (for transmission) and reassembly,

- packet formatting, and packet transfer and reception across the Transmission Service interface,

- Transmission Service interface control.

Message fragmentation and reassembly. The unit of transfer through the Transmission Service is a packet comprising header and data. Where a message is longer than can be transferred in a single packet the message is broken down into message fragments which are transferred in a sequence of packets and reassembled at the destination.

The packet size is a system parameter and can be adjusted to fit the traffic pattern. Only DATA messages can be greater than the maximum data space size for a packet and will be fragmented if necessary. Reassembly is controlled by the message sequence number on the connection and the packet number within the message.

Packet formatting, transfer and reception. A packet header comprises the destination or source network address, the packet length, the destination logical channel number, and the message and packet sequence numbers. Control of the transfer takes place via the control interface of the Table Ronde communicator.

Transmission Service interface control. Facilities are provided across the interface to the Table Ronde communicator

- to reset the equipment,
- to logically disconnect it from line and connect it to line,
- to run loopback tests,
- to run diagnostic transmissions.

These facilities can be invoked at node start up or when an error has been detected.

2.3.2.1.3 Transmission Services.

The Transmission Service functions are provided by a set of Table Ronde communicators linked in a ring configuration. The communicator control functions provide for:

- network start up, close down and recovery from transient faults,
- communicator start up, close down and restart,
- for the reliable transmission of packets between communicators (on the basis of a network address).

The internal operation of the communicator and of the Transmission Service are described more fully in section 3.2.1 and the associated annexes.

2.3.2.3 Work Station Support

All work stations interface to the Transmission services via a serial node supporting a V24 compatible interface. The Transport Control and Network Control functions are then divided between the work station and the serial node. The actual division of functions depends upon the work station involved. A work station and network interface module are assumed to be located together so that no error control procedures are used on the link but there is a flow control procedure.

2.3.2.3.1 Server Computer Support

A server computer can support a number of virtual calls at the same time. The link to the serial node is full duplex and packets carrying messages or message fragments for different calls are multiplexed over the link in both directions.

The Transport Control functions are located in the work station. The major part of the Network Control functions are in the work station and interact with the serial node to control the communicator interface by the exchange of control and information transfer packets.

2.3.2.3.2 User Computer Support

A user computer can only support a single virtual call at one time and the link to the serial node is half duplex.

Transport control is shared between station and node. Call set up is carried out through the action of the serial node in response to the transmission to it of a CONNECT message. Call clear down is similarly an action of the serial node in response to a DISCONNECT message from the User computer or to a CLEAR message from remote end of the connection.

Network control is similarly shared. The work station controls message fragmentation and reassembly but the serial node is responsible for setting the network address. The work station and serial node interact by the exchange of control and information transfer packets.

2.3.2.3.3 Teletype terminal support

For Teletype work stations all control functions are provided within the serial node. A single virtual call is supported and the link to the work station is half duplex. For input from the terminal the serial node assembles the input character string into a message and adds the appropriate header depending upon the state of the virtual call. For output the node strips off header information and outputs any character string that the message contains.

At initialisation time the user declares a message termination character and an escape character. The message termination character causes the serial node to turn round the link. (that is, to be prepared to receive a message after the message has been sent). The escape character allows the input of a standard control character to clear a call.

Thus, following initialisation of the node, the terminal user inputs a string which is taken as the logical network identifier of the call destination. If the call request is successful a prompt is displayed and the terminal user can then input a character string to send, or put the terminal in the state to receive from the called party by typing the termination character. The call is terminated by typing the escape character followed by a code character: typing escape followed by the message terminator returns the system to the normal input state.

2. THE TABLE RONDE SYSTEM

- From Minicomputer Forum, Online 1976

This paper describes a prototype implementation. The system proposed for the network is a production version operating at up to 50K bit/sec and with an improved interface and diagnostics.

Current prices are:	10000FF per communicator
	4500FF per serial node
	for quantities of 10 or more

Using the Cambridge data ring

Martyn Johnson
Cambridge

Using the Cambridge data ring

M. A. Johnson

Introduction

The data ring at Cambridge is now in use, and a variety of machines are connected to it. The aims of the current software work on the ring are twofold:

- to provide a convenient means of transferring information between the machines, several of which cannot otherwise communicate with anything else.
- to research into the types of protocols most appropriate on the ring, and the development of distributed operating systems.

Basic block protocol

The packet of data sent around the ring is very small (16 useful bits). Most ring transfers are done in terms of a larger unit - the 'basic block'. This has a header packet, a routing packet, 1-1024 data packets, and a checksum packet. The header packet contains a distinctive bit pattern, some type bits, and a count. The route packet consists of some reserved flag bits, and a port number, which is used to route the data to the correct place in the target machine. The checksum packet is there partially for error detection, but its main purpose is to protect against framing errors caused by erroneous detection of header packets. It is intended that basic blocks should be handled at a very low level - e.g. microprogram or dedicated microprocessor, but this is not essential. A policy decision has been made that all errors noted at this level (block timeouts, unknown port number, genuine ring errors etc.) should be ignored. Thus the interface presented to the next level of software is one in which blocks either arrive correctly or fail to arrive at all.

Higher level protocols

Higher level protocols are built on top of the basic block protocol. Wherever possible, use is made of 'stateless' protocols, i.e. those in which state information is preserved at one end of the communication only, and there is no long lasting connection. Such protocols are generally designed in such a manner that any error which occurs can be dealt with by a simple retry. The file server protocol consists entirely of transactions of this type. A typical transaction, read, is done as follows. The client sends a basic block containing the message "send me X words of file F on port P, and acknowledge on port A". The client merely checks that the acknowledgement is OK and that the correct amount of material arrives. If anything goes wrong (e.g. no reply after a timeout interval) the client simply tries again (changing the port number P in case the original request is eventually serviced). With care, many services can be designed in this manner.

For some purposes, state preserving protocols are essential. At present one of these is defined, the byte stream protocol. It provides a pair of synchronised byte streams with flow control. Most of the facilities of the Post Office Packet Switching Study Group 3 Transport Service proposal are provided, but it is simple enough to implement on a Z80 microprocessor. (Most of the restrictions are in the area of non-local addressing; extension to provide these facilities would not be very difficult).

A brief summary of ring research and development at Cambridge.

The CAP computer (a machine built for research into protection in operating systems) provides various services to mini computers. File transfers are possible using a simple file transfer protocol built on top of the byte stream protocol. Terminal access via the ring should be available soon.

An LSI/4 mini computer with 160 Mb of disc storage will be used as a file server. The design is complete, and implementation is in progress.

It is planned to make a major change to the CAP's operating system, to enable it to use the file server instead of its own disc, doing swapping via the ring.

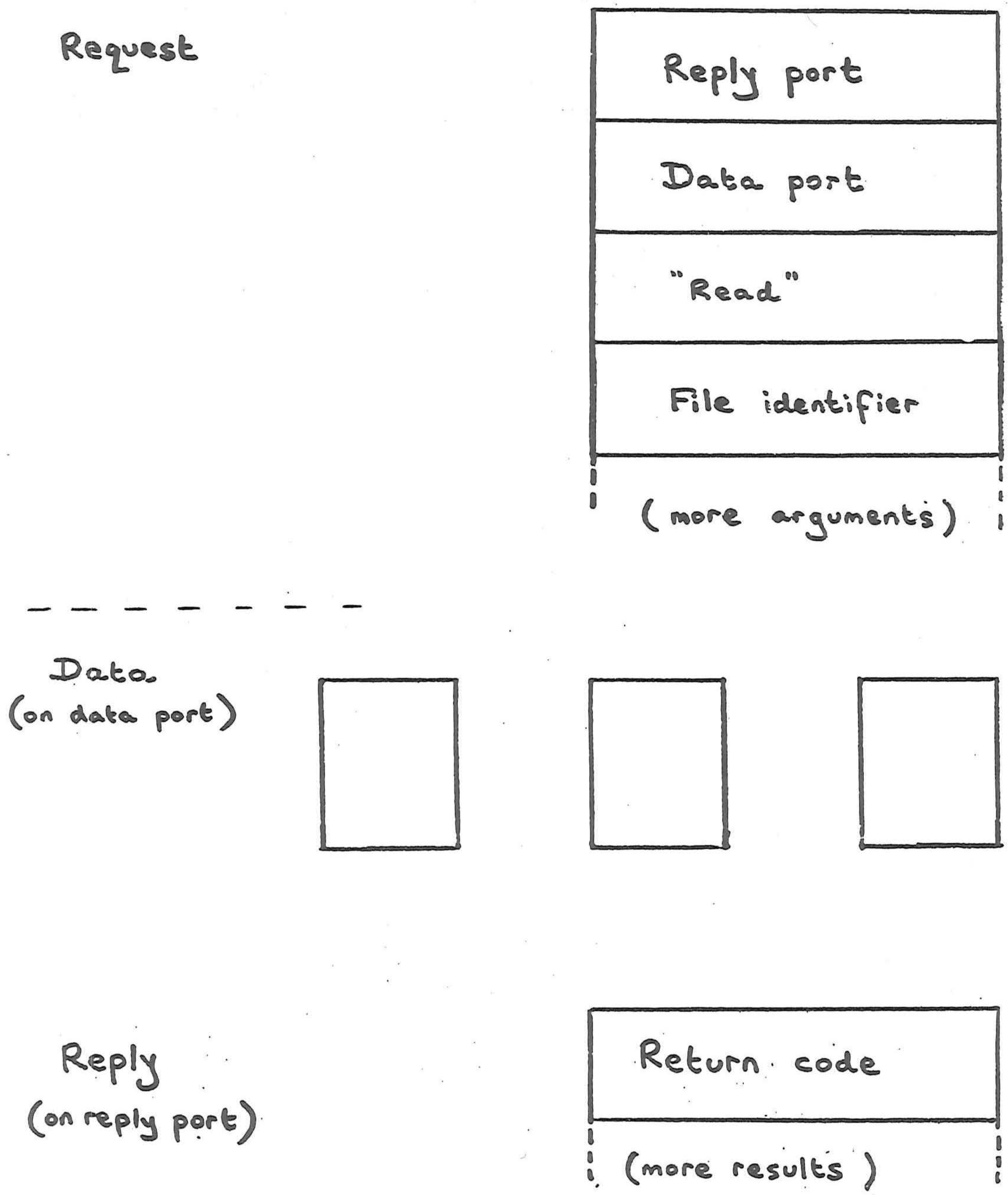
A Z80 based microprocessor system has been produced. These can a) interface the ring to devices such as terminals and printers, and b) provide simple services such as name lookup. Each is usually dedicated to a single purpose; 4 are currently built and working, ultimately 6-10 will be in use.

A high speed DMA interface for mini computers, based on the 8X300 microprocessor, has been designed and the prototype is being constructed. It will handle the basic block protocol, and has facilities for rebootstrapping and debugging its host. Six LSI/4 mini computers have been bought to interface in this manner, and it is intended that they will have the ring as their only peripheral. The development of techniques for using them effectively is a research topic.

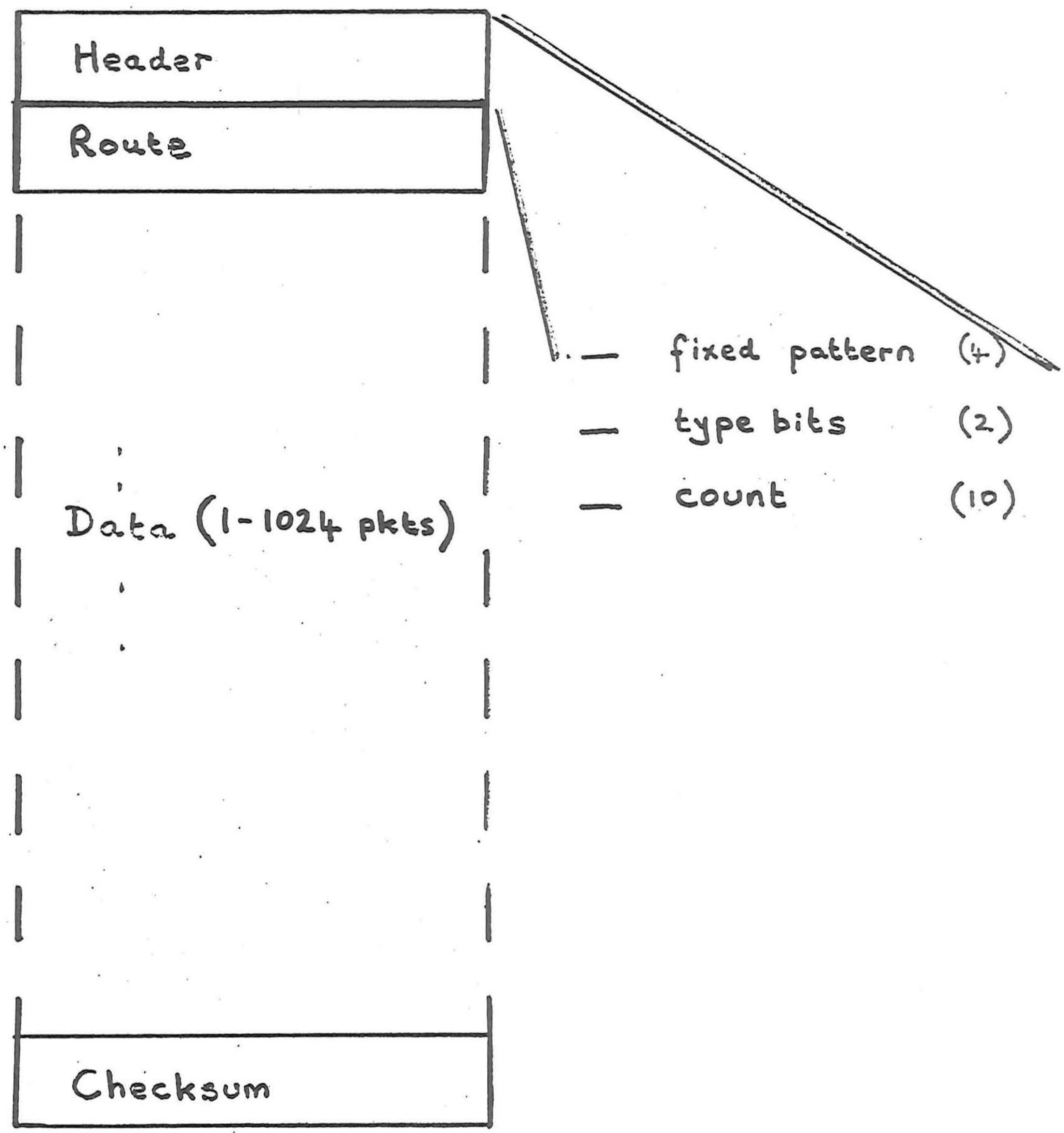
The Computing Service intend to interface their mainframe (IBM 370/165) via a PDP11 to the ring. This gives potential access to wider area networks.

Typical fileserver transaction

(read)



Basic block


Header
Route
Data (1-1024 pkts)
Checksum
fixed pattern (4)
type bits (2)
count (10)

The Kent implementation of the Cambridge ring

Matt Lee
Kent

University of Kent at Canterbury

Computing Laboratory

Ring Project

Summary of the Report given at Networkshop4 on the Kent Implementation of the Cambridge Ring

Basic Brief

a) Build an exact copy of the Cambridge Ring and connect 5 PDP-11's to it.

Problems of Importing the Cambridge Design

a) Assembling a current set of documentation. At the time the documentation was needed, changes were being made to the Work Station and Monitor Station designs. This meant rough diagrams, intended for guidance only, were available.

b) Making design decisions in the light of the available documentation. It was decided that the most recent designs of Repeater, Work Station and Monitor Station should be adopted because:

i) connection to future hardware (e.g. the LSI chips) would be straightforward.

ii) construction of parts of the Repeaters and Work Stations could be started, and this work would fill the time until the new designs were fully documented.

Experiences of Building the Ring

a) Once designs were fixed for the Repeater and Work Station construction was straightforward, as was construction of the Ring Power Supply.

b) Monitor Station construction was again straightforward, but both the Cambridge prototype and the Kent prototype were completed at about the same time. This meant commissioning the Monitor Station was slowed slightly by intermittent calls to Cambridge to confirm and/or accept modifications.

c) A constructional error delayed the Work Station wire-wrapping by three days.

Timescales of the Work to Date

a) A record of the timescales for the construction of the Repeaters, Work Stations and Monitor Station is shown on the copy of Slide 1 at the end of this report.

Costs

a) The costs of parts of the Ring and of an example 10 node Ring are shown on copies of slides at the end of this report. They are:

Slide	Title
2	Repeater
3	Work Station
4	Monitor Station
5	PDP-11 Interface
6	10 Node Ring

b) Notes.

i) The costs shown are based on the prices of components between July 1978 and May 1979.

ii) The labour cost is based on a rate of two pounds per hour.

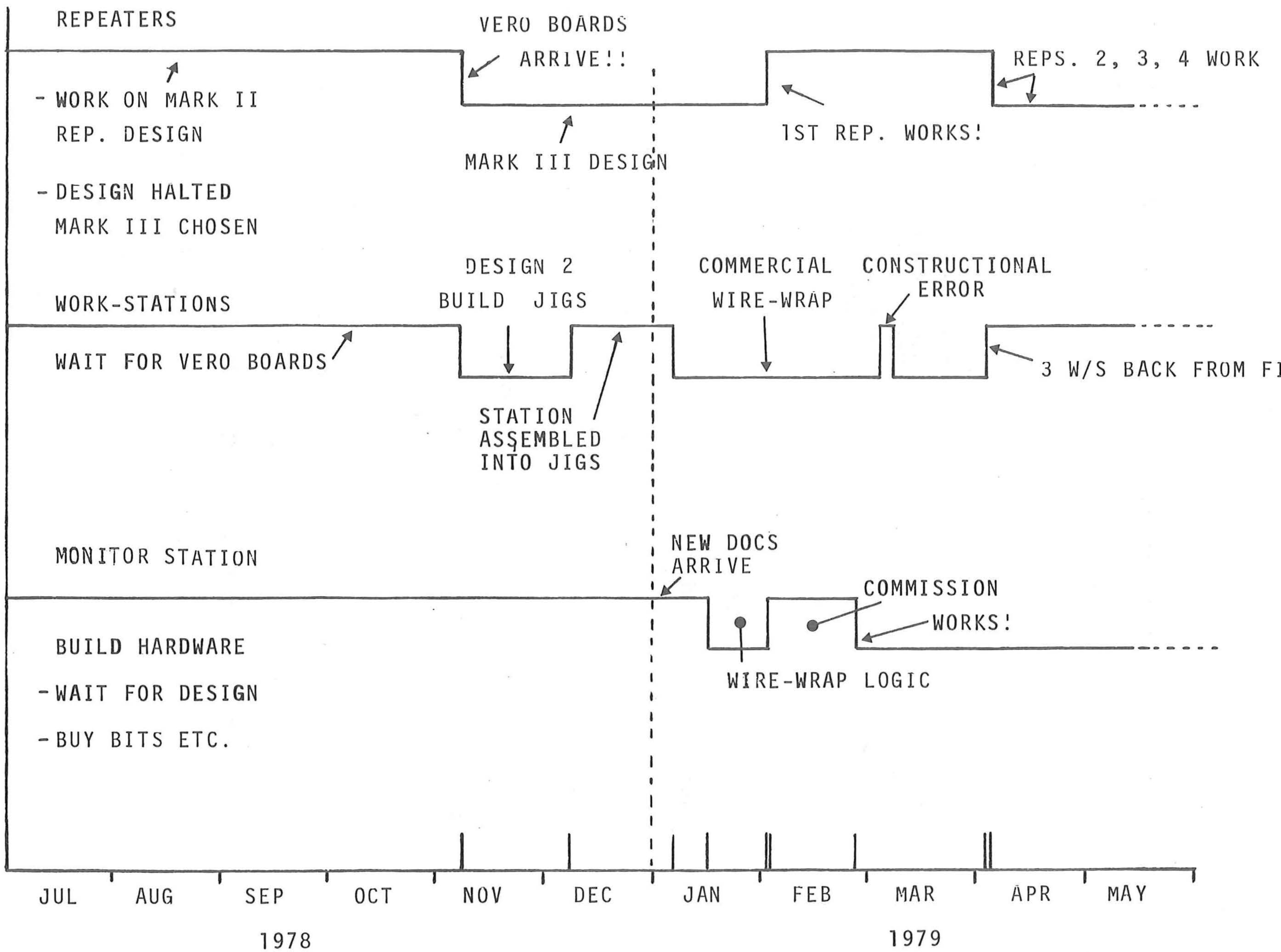
iii) The time spent by the author on the project is not shown.

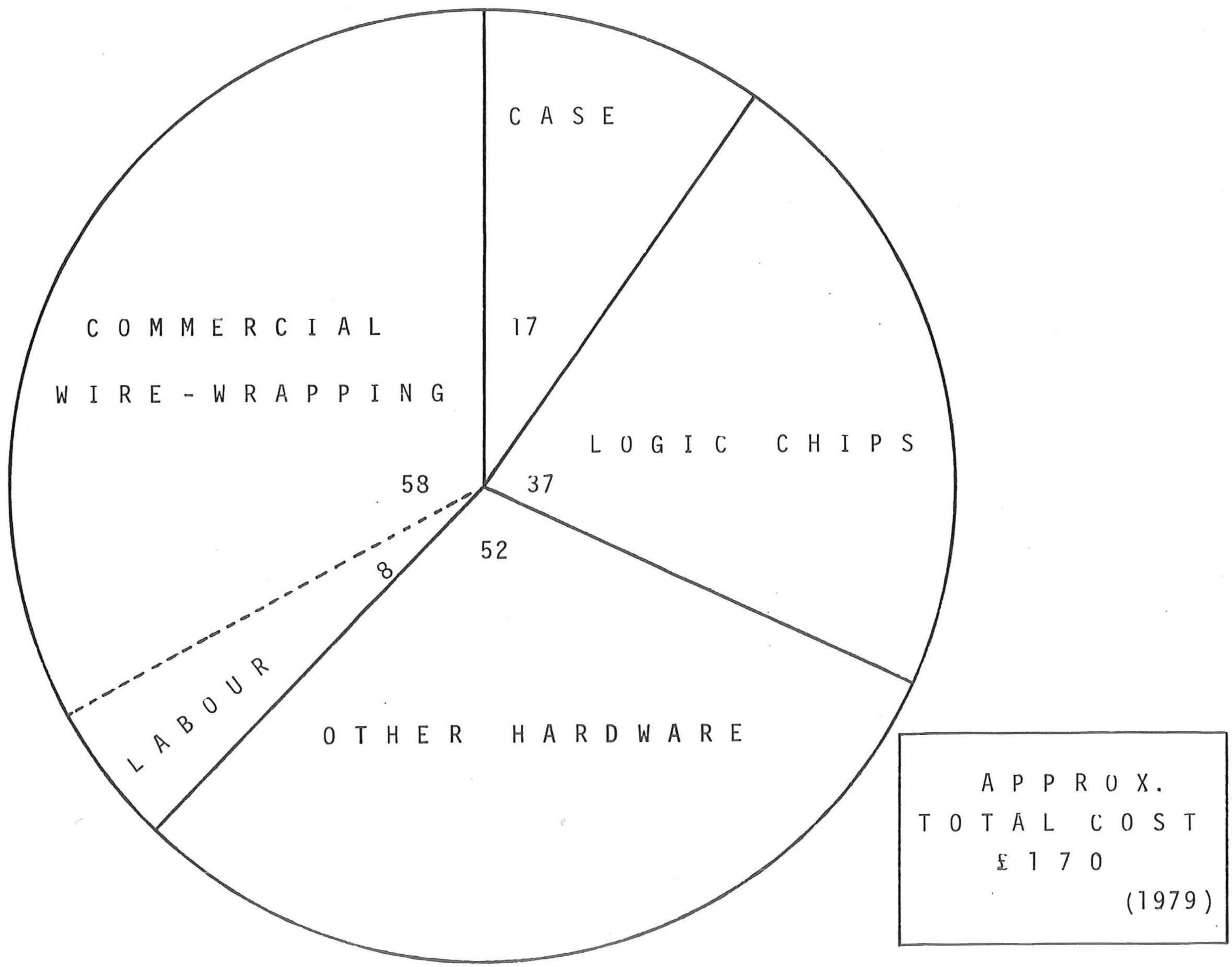
Acknowledgement

The Ring at the University of Kent Computing Laboratory is based entirely on the Cambridge Ring. Without past and continuing help from the Computing Laboratory at Cambridge, the implementation at Kent would not have been as successful as it has been to date.

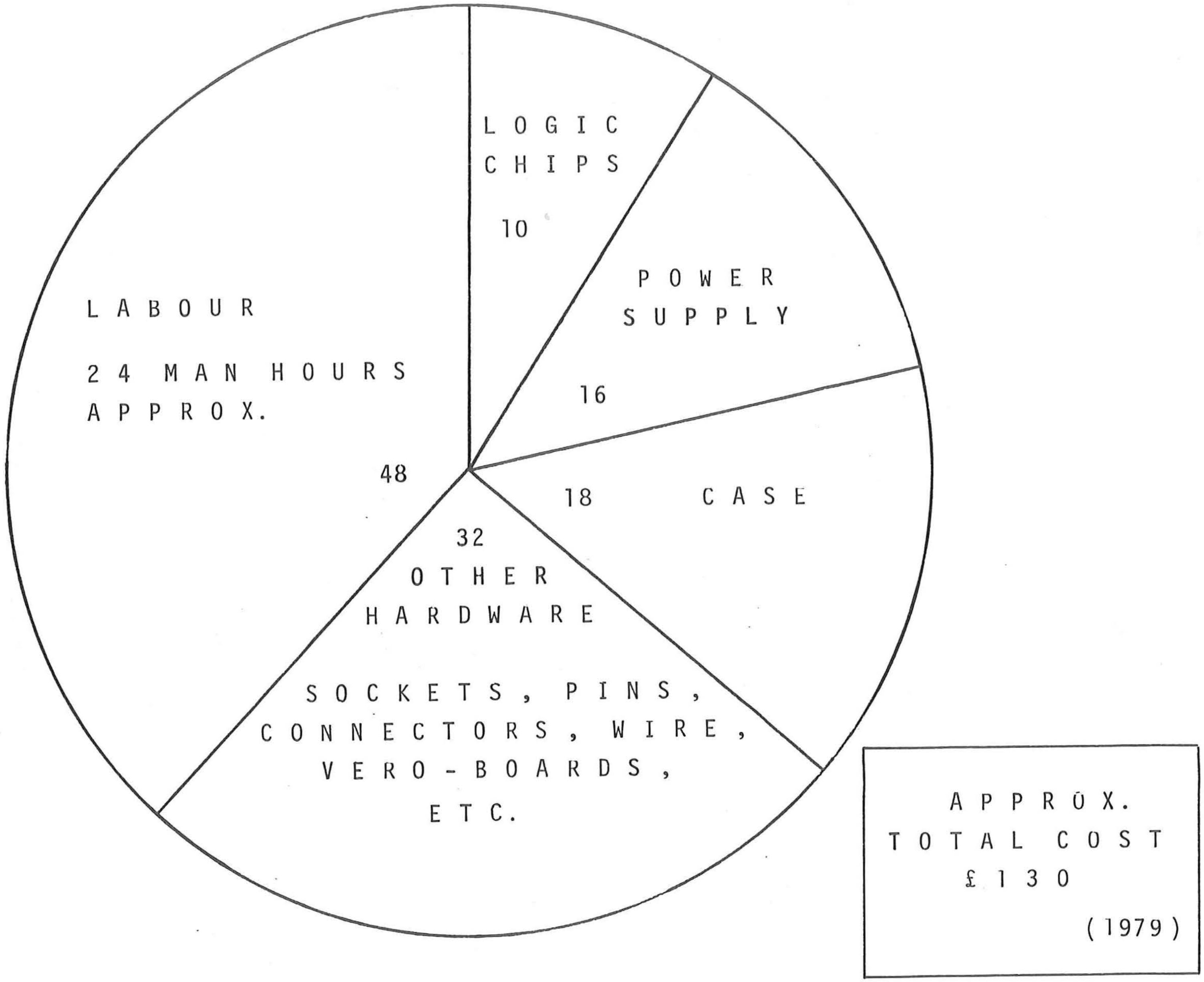
M.N.A. Lee,
Experimental Officer.
April 1979.

WHAT'S BEEN GOING ON

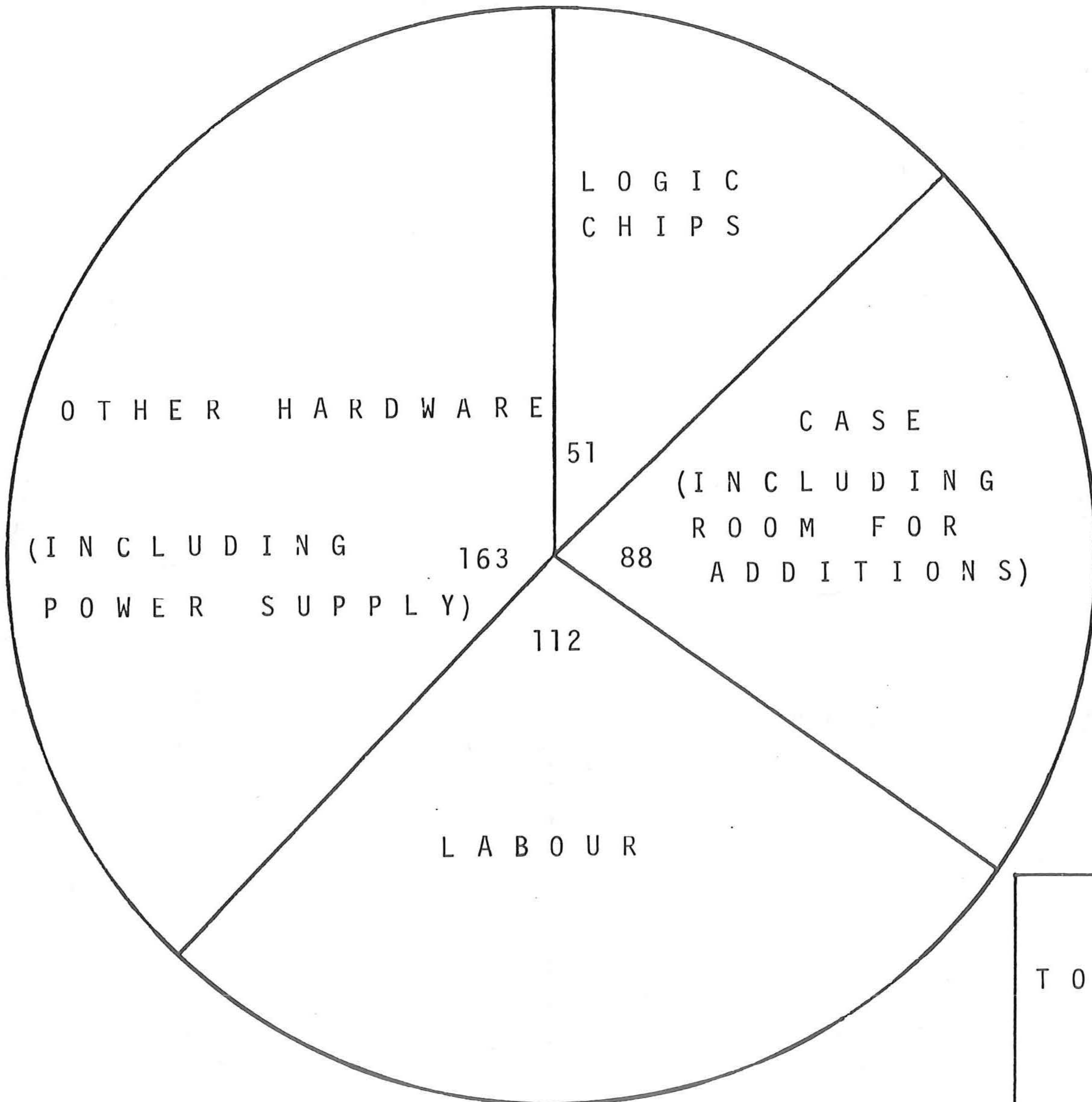




WORK-STATION

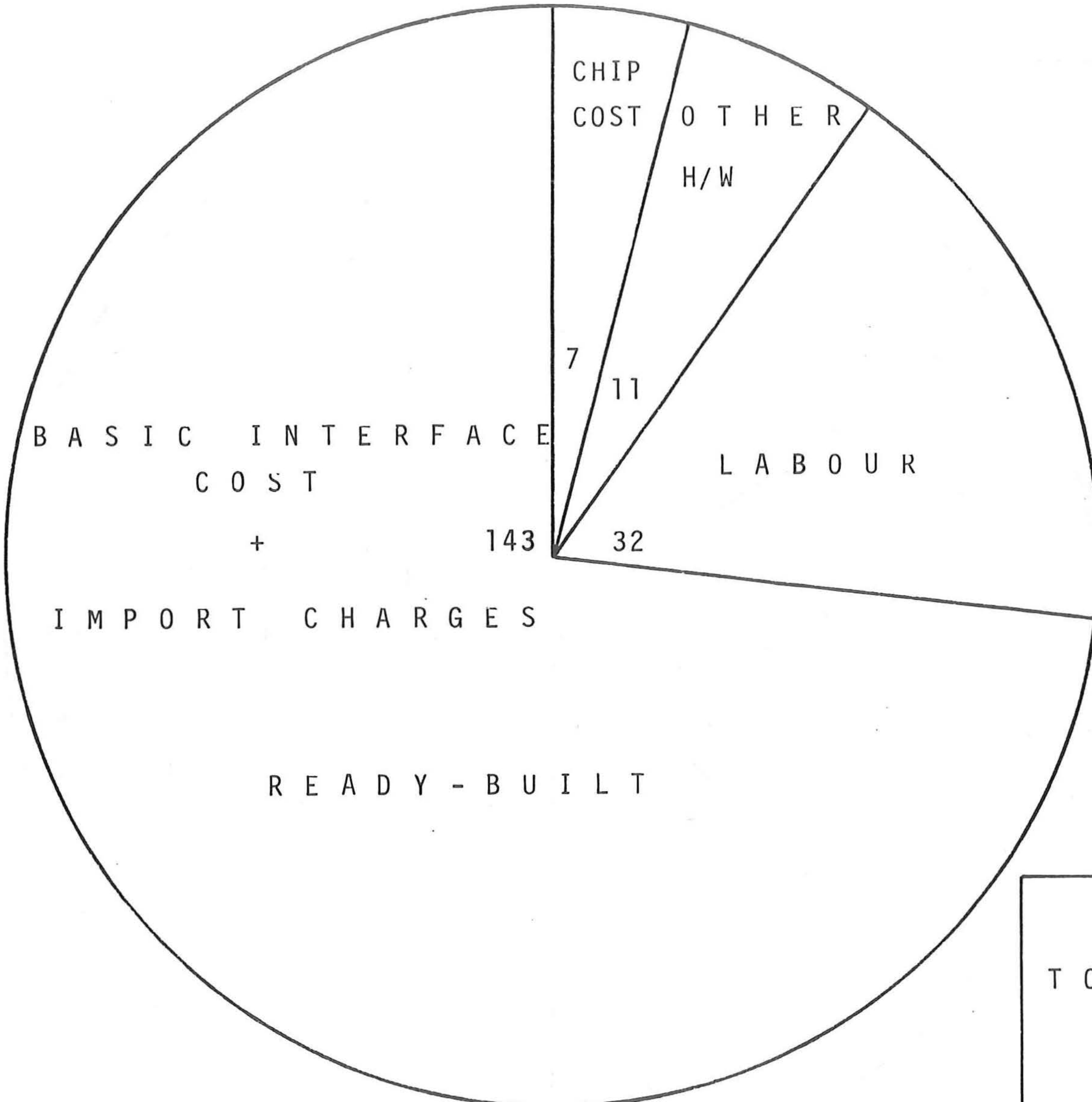

LOGIC CHIPS
10
POWER SUPPLY
16
CASE
18
32
OTHER HARDWARE
SOCKETS, PINS, CONNECTORS, WIRE, VERO-BOARDS, ETC.
LABOUR
24 MAN HOURS APPROX.
48
APPROX. TOTAL COST £130
(1979)

REPEATER



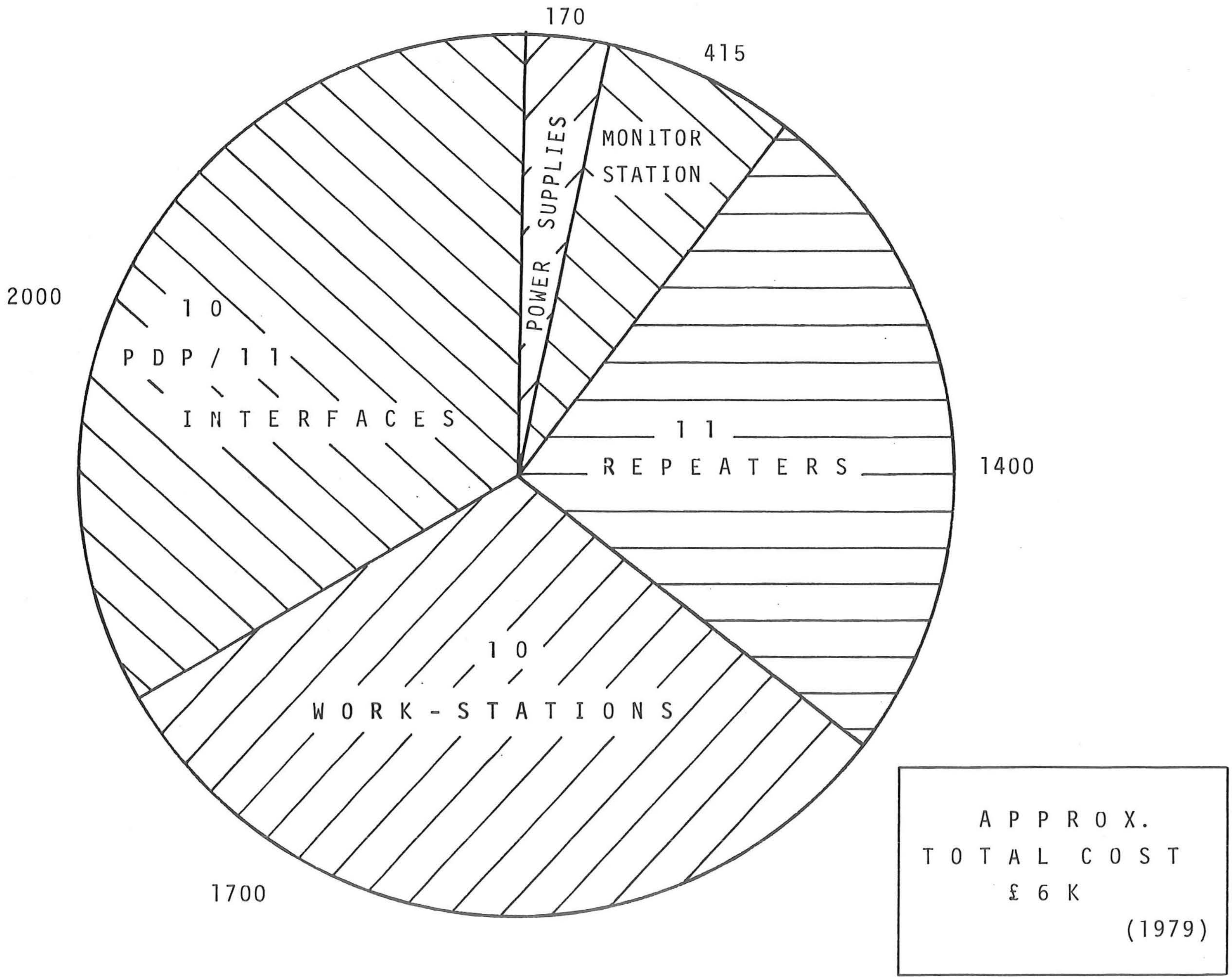
APPROX. TOTAL COST £420 (1979)

MONITOR STATION



APPROX.
TOTAL COST
£195
(1979)

PDP/11 INTERFACE



170
415
POWER SUPPLIES
MONITOR STATION
2000
10 PDP/11 INTERFACES
11 REPEATERS
1400
10 WORK-STATIONS
1700
APPROX.
TOTAL COST
£ 6 K
(1979)

10 NODE RING

Administering the use of networks

John Rice
Liverpool

ADMINISTERING THE USE OF NETWORKS

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Introduction

This paper examines the problems with which Computer Centre management will be faced when PSS connections are available from the university campus. Freely available use of PSS facilities could lead to considerable uncontrolled expenditure and therefore it will be necessary to preserve solvency by preventing undesirable incoming and outgoing PSS access and use whilst ensuring that the level of service provision is sufficient to meet the needs of genuine users.

PSS Connection and the Campus

For the purpose of the ensuing discussion it will be assumed that the typical university campus contains a campus network which is linked to a regional network, which itself is linked to the PSS network. For our purposes the regional network may be considered as a part of the PSS network (as in most cases it will be).

We may therefore identify the following methods of connection from the campus to PSS (see Figure 1):-

A. Packet Mode

1. Campus network connection via a Gateway
2. Mainframe connection
3. Character terminals connected through a local concentrator providing PAD facilities.

B. Character Mode

1. Character terminals directly connected to a PSS PAD
2. Character terminals connected to a PSS PAD via the PSTN

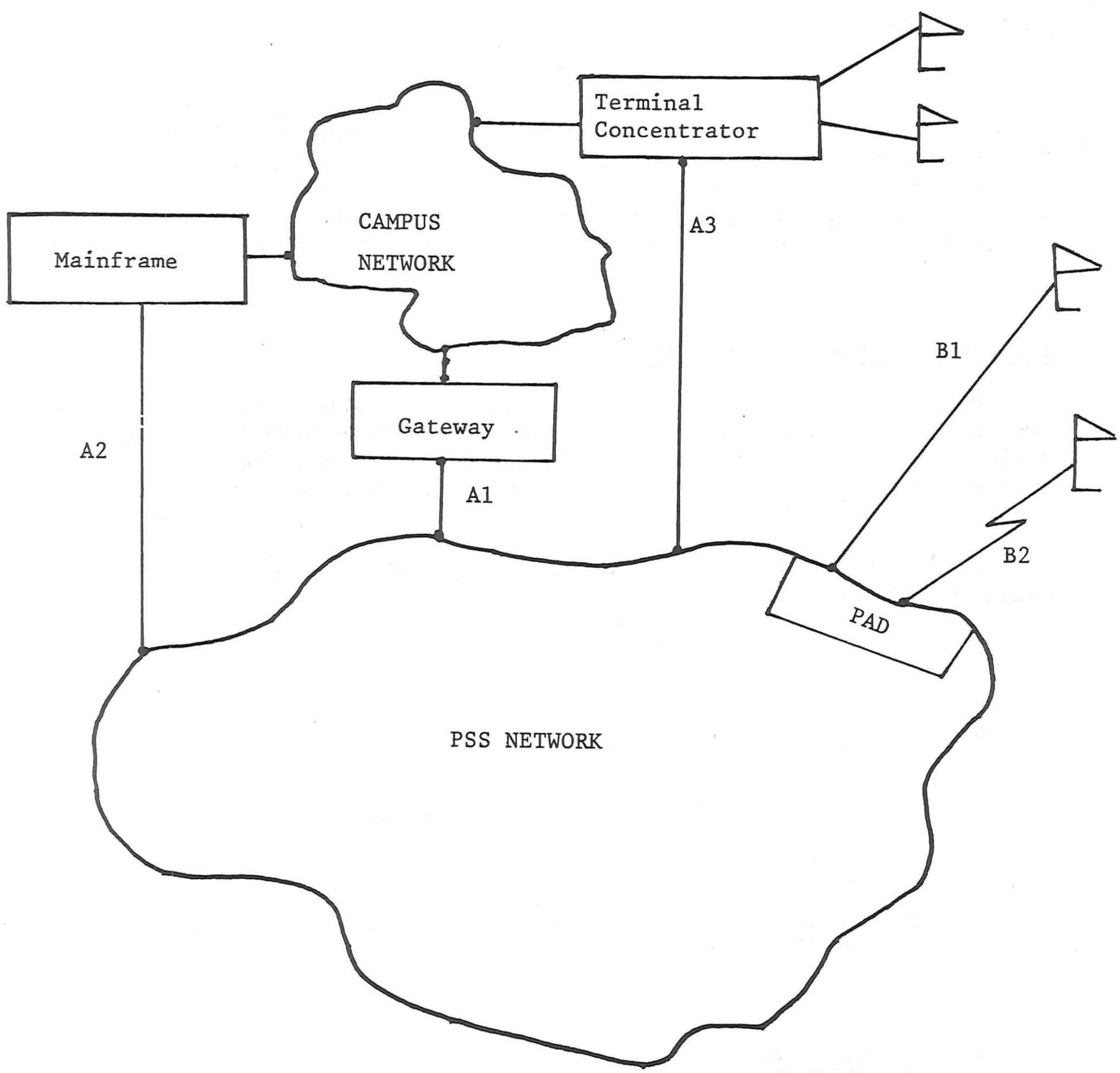

Figure 1: PSS Connections from the Campus

Areas for Control

PSS tariffs cover three major areas, namely Access, Usage and Facilities. Since charges may be accumulated under each of these headings it is necessary to consider the control of each area separately.

An associated problem is caused by the need to bill directly the consumer of network services from the campus. The implications of this will also be considered.

Controls in the Absence of a Transport Station

Access Control

It is quite likely that connections both to and from equipment on the campus will use X3, X28, X29 facilities built directly on top of the X25 connection. The implications of such a mode of connection need to be considered. (Typically this would apply to connections B1 and B2 (See Figure 1) and also possibly A2 and A3).

Firstly it will be necessary to ensure that there is no abuse of the calling capability. That is, it must be possible to prevent users from making large numbers of unsuccessful call connect attempts as each such attempt is chargeable.

Secondly it may be necessary to restrict access to certain facilities. An example of such a facility is the placing of international calls. Here a useful spin-off of a reverse charging policy may be utilised, namely that international reverse charging is not permitted. This method of control may easily be implemented in a terminal concentrator providing local PAD capability A3 (See Figure 1). The implication of a reverse charging policy of course is that each callable national site should be prepared to accept reverse charges and consequently have a means for subsequently billing them to the caller. An alternative method of reducing access is by the use of the closed user group, of which more later. For character mode terminal access only by the PSTN, use of multiple Network User Identifiers (for each university department?) provides a simple method of billing (P.O. direct to Department), if not control.

Finally, the Post Office could be prevailed upon to provide a subscription time option with international calls barred.

Unfortunately, what most universities are likely to require is a selective barring, and in the Triple - X environment it seems that multiple addresses with most barred would then be the only solution.

The foregoing has referred to outgoing access from the campus to PSS. It is clearly necessary for those sites wishing to provide remote access to their mainframe via PSS to provide adequate facilities for billing the use of local host facilities and PSS reverse charges (if accepted). It might appear at first that with reverse charge acceptance one simply accepts a call, allowing access to a terminal channel, and then bills the user who subsequently "logs-in" to the host. However, this would not provide for the recovery of costs if the user fails in his "log-in" attempt. In some implementations it may be possible to provide checks of the calling party on the mainframe's FEP which is answering calls, but this may lead, in the general case, to unacceptable localised mass storage requirements.

Traffic Control

Ideally one would like to control the cost of the traffic which campus users can generate over PSS. The worst-case situation is when such access is via the PSTN, since any controls in this case must lie within PSS itself. Since call charges (if the subscription-time option is exercised) are notified in terms of duration and volume it is unlikely that direct cost controls would be provided.

If the Post Office were to provide an option to limit the segment count and call duration on a per-call basis this might go part of the way to solving the problem. However, since the equipment accessing PSS over the PSTN may be a computer, which could re-connect calls quickly, the need arises for an additional limit on call frequency. Alternatively, a cumulative segment count limit (over a month, say) could be a useful subscription-time facility.

Control with a Transport Station

It is a debatable point as to whether or not the collection of call statistics is a proper function of the transport service or of a superior session control service. For the purpose of the following discussion it will be assumed that such a service is provided at the transport level.

Access

The subject of Transport Service addressing is still under discussion. However, irrespective of the conclusions reached, the following possible implementation features should be considered:

(a) the use of Titles as the only permitted TS addresses; this would limit access through the TS to a set of addresses contained in local tables

(b) blocking on certain destination addresses; e.g. international addresses

(c) blocking access from certain local network calling addresses

Whilst primarily in this section we are concerned with functions of the gateway between the campus network and PSS, the discussion is in terms of TS implementation, since this is of more general interest.

In the particular context of the gateway, which we may assume to be on a host, the file store requirement of the above features is not a problem.

Usage

Usage must be monitored in terms of volume and duration (preferably compounded as cost) and the ability at liaison set up to specify volume and duration limits (with suitable defaults) would be useful, as would notification of liaison cost on disconnection. When limits were reached the TS would be required to automatically disconnect the call.

Facilities

A user access profile held at the gateway and related to campus users by their local account codes could incorporate not only access and usage control bounds but also permitted facilities (such as reverse charging).

Billing

Users, particularly computers which access PSS sites from the campus network, will require charge details on a per call basis. The simplest TS implementation with one call per network per liaison (i.e. no multiplexing) could utilise the PSS call statistics facility to provide such data. An implication of a multiplexing TS would be the necessity of incorporating such statistics collection within the TS. One advantage of TS intelligence should be the notification of actual costs for all calls.

The question of the level of detail to be provided at the end of an accounting period seems open. The provision by the P.O. of accounts information itemised by call is only likely to be of value if it is accessible in machine-readable form.

Standardisation

It will greatly simplify matters for the local network user if the campus network implements the same call charging algorithm as PSS.

Charging

The spectre of charging for computing within the university community has recently re-appeared and future campus networks need to be constructed with this in mind. "Presumably each local net has effective techniques for recording charges and collecting fees from local hosts" [1]. Is that true of all UK university campus networks? Should it be?

Certainly if apportionment of PSS charges between local campus users is required, in accordance with the assumption: "Presumably each local net authority will collect both local and internet fees from local users, exchanging accumulated internal charges with other nets periodically" [1], then certain gateway features will need to be present, namely machine access to both local and PSS accounts on a call by call basis.

Closed User Groups

To end on a practical note, if we cannot exercise total control over our users use of PSS, we need to implement the least restrictive effective limited control.

One way of exercising such control is via the closed user group facility. Three such groups may be identified:

(a) Regional CUG

this would permit incoming access from all PSS subscribers and outgoing access to the National Centres CUG for each member

(b) National Centres CUG

incoming access would be permitted from the members of all regional CUGs.

(c) Special-Arrangement CUGs

these would be established on an ad-hoc (charged!) basis to allow specific inter-regional access e.g. a Database CUG could be set up.

The application of the CUG facility to the university environment is recommended for serious consideration.

Conclusions

The subscription-time facilities of PSS require close examination to determine those most useful for the control of PSS use within the university community. A recommended set could be defined by the Joint Network Team.

Further, a TS implementation guide is urgently required which seriously addresses the subject of user control.

Without such controls the cost to the universities in PSS charges resulting from undesirable access (intentional or unintentional) could adversely affect policy on the use of PSS by genuine university users.

Reference

1. C. Sunshine "Interconnection of Computer Networks" Computer Networks Volume 1 Number 1

23.4.79 JDR/MPED

Summary and concluding remarks

Roland Rosner
Network Unit

SUMMARY AND CONCLUDING REMARKS

Roland Rosner

This Networkshop has left the very definite impression that more and more people in the community are now concerned with network implementation. The discussions have therefore had much more of a practical flavour than at previous workshops where the emphasis was on pure protocol definitions as paper exercises.

An important corollary to this change of balance is the much wider base of experts that has now come into being in the community.

We have learnt a lot about the Transport Service and it is particularly pleasing to note how much effort has gone into its definition by members of Post Office Study Group 3. The Protocols Unit was responsible for organising the meeting which gave SG3 its new lease of life. Perhaps one of the more stimulating discussions was on the tariff implications of X25 from which it emerged just how vulnerable standards are to crude economics. Structuring a tariff in a particular way can lead to tariff-cracking by technical means which could effectively destroy the standard.

Work has at last begun on the job transfer protocol problem and there are grounds for hoping that a definition may be ready by the end of the year. Precedent suggests that, no matter how many willing experts make part-time contributions, protocol definitions are only produced when there is at least one individual who can devote himself to the work for a substantial fraction of his time and coordinate all the input generated by the others.

More and more sites are now thinking about plans for local area communications. The ideal is a high bandwidth system with widespread access points, cheap interfaces, high reliability and the ability to carry traffic from synchronous and asynchronous devices. The Cambridge ring is a candidate for use in some places; in other environments, centralised X25 switches are under consideration. There is a risk that, in the absence of supported products from manufacturers, many centres will undertake their own developments. The JNT will be recommending to the Computer Board that funds be made available for the exploitation of the different techniques as pilot projects at a very limited number of sites. There will also be negotiations with manufacturers to stimulate the early availability of catalogue items. The excellent presentations on the ring

showed some of the difficulties to be overcome in developing fully engineered products out of research projects.

Development work on devices such as concentrators, RJE stations and gateways will be coordinated to ensure the emergence of widely applicable products and to reduce the risk of duplication. Projects carried out as contracts under the auspices of the JNT will follow the already established pattern which seems to be operating quite successfully. This entails the formation for each such project of a steering group comprising appropriate experts from sites in the community acting as consultants to the JNT. Such a group then contributes to a tight functional specification of the work to be carried out and holds periodic meetings to monitor progress.

The JNT would welcome information on any current projects which are felt to have wider than purely local applicability.

The discussions have shown that the next Networkshop (to be held at Kent from the evening of Tuesday 18 September until Friday 21 September 1979) should include coverage of:

PSS X25 Level 3
The final version of the Transport Service Definition
The interim report on the Job Transfer Protocol
Gateways
Communications Hardware
How to use old kit in a modern networking environment.

18 May 1979

Papers not included

The following papers were received too late for inclusion in the proceedings:

Report on the GEC 4000 range activities for networking - John Horton (GEC)

Report on the Honeywell Multics activities for networking - Kit Powell (Avon)

General description of the Post Office Study Group 3 proposals for a transport service - Peter Linington (Protocols Unit)

Implications of Post Office tariffs on transport service - Peter Linington (Protocols Unit)

Job transfer - what facilities are needed? - Jeremy Brandon (Queen Mary College)

The Structure of a job transfer protocol - Andrew Chandler (CADC)

The South West region's requirements for a campus switch - Howard Davies (Exeter)

Progress report on the Cambridge ring - Andy Hopper (Cambridge)

This report is one of a series published by the Department of Computer Science at the University of York. The purpose of publication is to present our experience and ideas to inform colleagues and friends in a way which strikes a balance between ad hoc memoranda and formally refereed papers. It is intended that appropriate reports shall be revised in the light of comments received and offered for publication in the technical literature.

The numbering of reports in the series is continuous, but the report covers are colour coded according to the technical content. (Yellow for teaching and research, blue for the Computing Service.)

Previous reports available

5 J. Holden and I. C. Wand, *Experience with the programming language Modula*, June 1977

6 A. Burns, *Heat transfer coefficient correlations for thermal regenerator calculations — transient response*, June 1977

7 C. Runciman, *Toward more effective programming*, January 1978

8 I. C. Pyle, *Annual Report to SRC on Project B/RG 76970 'Real time programming languages for industrial and process control'*, January 1978

9 A. J. Willmott and A. Burns, *The recuperator analogy for the transient performance of thermal regenerators*, 1978

10 *Annual Computing Service Report 1976/77*, 1978

11 R. C. Thomas and I. C. Pyle, *The Adaptable Terminal: A user adjustable man-computer interface*, March 1978

12 I. C. Pyle, *Methods for the design of control software*, April 1978

13 I. D. Cottam, *Functional specification of the Modula compiler*, June 1978

14 I. C. Wand and J. Holden, *MCODE*, August 1978

15 I. C. Wand, *Dynamic resource allocation and supervision with the programming language Modula*, August 1978

16 J. Holden and I. C. Wand, *An assessment of Modula*, November 1978

17 I. C. Wand, *Modula distribution and promulgation 1978*, January 1979

18 *Annual Computing Service Report 1977/78*, 1979

19 N. Wirth, *Reflections about Computer Science*, Text of a lecture given at York in July 1978

20 I. D. Cottam, *Functional specification of the Modula compiler, Release 2*, March 1979

21 I. C. Pyle and I. C. Wand, *Final report to the SRC on Project B/RG 76970 'Real time programming languages for industrial and scientific process control'*, May 1979

22 W. Freeman (editor), *Proceedings of the "Ironman" languages seminar, 30 May 1978*, June 1979.

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